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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

World Power Conference (Third Notice).

The British Empire Exhibition (Thirteenth Notice).

British Wire Working Machinery—No. I.

100 Years of British Railways—No. III.

Royal Agricultural Show—No. IV.

A Remarkable Drop Hammer and its Work.

35-Ton Electric Surface Traverser.

Lloyd's Register Book.

PUBLIC NOTICES

Hong Kong Waterworks.

It is hereby notified that sealed Tenders in triplicate, which should be clearly marked "Shing Mun Scheme—First Section—Tender for North and South Tunnels, South Conduit, and Contingent Works," will be received at the Colonial Secretary's Office, Hong Kong, until Noon on Monday, the 8th day of September, 1924.

The work consists of the DRIVING and necessary LINING of TWO TUNNELS, approximately 2160ft. and 4680ft. in length, through the Smugglers' Ridge and Golden Hill respectively; the CONSTRUCTION of an OPEN CONDUIT, approximately 2950ft. in length, and CONTINGENT WORKS.

Drawings, conditions of contract, specification, bills of quantities, schedule of prices, form of Tender, articles of agreement, &c., can be inspected at the office of the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1; but spare copies of the above documents are not available here, and Tenders will only be received in Hong Kong. Contractors must Tender through substantial local agents, who will be required to guarantee their bona fide and, in the event of a successful Tender, must have power to sign a contract without delay. 6441

TENDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 31st July, 1924, for the SUPPLY of VALVES.

Forms of Tender, &c., may be obtained on application to the CONTROLLER OF SUPPLIES, H.M. Office of Works, &c., King Charles-street, Westminster, London, S.W. 1. 6419

The Director-General, India Store Department, Branch No. 12, Belvedere-road, Lambeth, S.E. 1, REQUIRES:—

1. POINT RODDING.
2. MILD STEEL BUFFERS FOR RAILWAY CARRIAGES.
3. MOTOR FIRE ENGINE, 250 Gallons per Minute.

Tenders due on the 29th July, 1924, for Nos. 1 and 2, and on the 6th August, 1924, for No. 3.
Tender forms obtainable from above. 6449

University College of Swansea
(A Constituent College of the University of Wales).

APPLIED SCIENCE DEPARTMENTS.

ENGINEERING.
Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: H. R. BURNESS, M.C., B.Sc. (St. Andrews), A.M. Inst. C.E., A.M.I. Mech. E.
Assistant Lecturer: J. SELWYN CASWELL.

METALLURGY.
Professor: C. A. EDWARDS, D.Sc. (Manchester).
Lecturer: A. L. NORBURY, M.Sc. (Manchester).
Assistant Lecturers: L. B. PFEIL, B.Sc. (Lond.), A.R.S.M.; P. M. MACNAIR, B.Sc. (Glasgow).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the Works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to Works of practical educational value to the Students.

Courses of study are provided: (1) for the B.Sc. Degree of the University of Wales in (a) Civil Engineering; (b) Mechanical Engineering; (c) Electrical Engineering; (d) Metallurgy; and (2) for Diplomas of the College in (a) Civil Engineering; (b) Mechanical Engineering; (c) Electrical Engineering; (d) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in September, 1924.

Particulars concerning admission to the College and of the Entrance Scholarships may be obtained from the undersigned.

EDWIN DREW,
Registrar.
Singleton Park, Swansea. 6395

County Borough of East Ham
EDUCATION COMMITTEE.
EAST HAM TECHNICAL COLLEGE:
EVENING CLASSES.

Principal: W. H. BARKER, B.Sc., F.C.S.

INSTRUCTORS are REQUIRED in the ENGINEERING DEPARTMENT of the Evening Classes to teach Practical Mathematics, Electrical Engineering, and Mechanical Engineering. Applicants must have had teaching experience.

Form of application, together with the conditions of appointment and scale of salaries, may be obtained from the undersigned on receipt of a stamped addressed envelope.

(Signed) F. R. THOMPSON,
Secretary.
Education Office,
Town Hall, East Ham, E. 6.
July, 1924. 6450

Public Tenders.—Corporations and other PUBLIC BODIES are INVITED, before issuing final invitations for Tenders, to COMMUNICATE with GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION. The Corporation has available for Disposal large quantities of Plant & Machinery and Materials in good condition lying at and arising from Government Factories and Works, the employment of which may, if their lists are consulted in the first place, effect great economies.—GEORGE COHEN, and ARMSTRONG DISPOSAL CORPORATION, Abbey House, 2, Victoria-street, S.W. 1. 6329

PUBLIC NOTICES

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive TENDERS as under:—Up to Noon on Wednesday, 30th July, for the SUPPLY of:—

1. LAMINATED AND ELLIPTICAL SPRINGS.
2. HELICAL AND VOLUTE SPRINGS.
3. CRANK AND STRAIGHT AXLES FOR LOCOMOTIVES.

and up to noon on 31st July for the supply of:—

4. WHEELS AND AXLES FOR CARRIAGES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for Nos. 1, 2 and 4 and 10s. each for No. 3 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: 91, Petty France, Westminster, S.W. 1.
16th July, 1924. 6410

Borough of Wallingford.
WATER SUPPLY.

The Corporation invite TENDERS for the following:
To DOUBLE the CAPACITY of the existing WATER TANK (15,000 galls.) by SUPPLYING and FIXING additional CAST IRON PLATES approximately 6ft. by 2ft. inside measurement.
To REMOVE existing TILED ROOF and REPLACE with IRON-FRAMED ROOF, WOODEN BATTENS and ASBESTOS TILES.
TO INCREASE LENGTH of existing RISING MAIN and all necessary PIPES by 6ft.

For further information and specification apply Manager, Waterworks, Wallingford.

Tenders should reach my office not later than Thursday, 31st July, 1924.

The Corporation do not bind themselves to accept the lowest or any Tender.

FRANCIS R. HEDGES,
6408 Town Clerk.

Borough of Portsmouth.
WIDENING OF THE CAMBER.
NEW QUAY WALL.

The Portsmouth Town Council invite DESIGNS and TENDERS for the CONSTRUCTION and MAINTENANCE in thorough repair for twelve calendar months from the completion thereof of the following WORKS, that is to say:—

The WIDENING of PORTSMOUTH CAMBER near the end of East-street, Portsmouth, by the REMOVAL of the projecting QUAY WALL there and the CONSTRUCTION of a NEW QUAY WALL and other WORKS in connection.

Copies of the general drawings, conditions and specification under which Tenders are invited can be obtained on application (accompanied by the sum of £3, which will be refunded on the return of the documents within seven days or on the receipt of a bona fide Tender accompanied by the documents required) to Mr. Arthur W. Ward, the Borough Engineer, Town Hall, Portsmouth, from whom any further particulars can be obtained.

The work will have to be carried out under the requirements of the Government Unemployment Grants Committee and the trade union rules in force in the borough.

Each Tender must be accompanied by detail drawings, specifications, and priced quantities of the scheme submitted by the person tendering.

Tenders, marked "Tender for Widening, Portsmouth Camber," are to be sent in on the form supplied and must reach the undersigned not later than 10 a.m. on Tuesday, the 12th day of August, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

F. J. SPARKS, Town Clerk.
The Town Hall, Portsmouth,
23rd June, 1924. 6407

PUBLIC NOTICES

County of London.
BELL WHARF OUTLET, SHADWELL.

The London County Council invites TENDERS for the CONSTRUCTION of a 4ft. diameter SEWER in BRICK and CONCRETE, of a total length of about 200ft., with WEIR CHAMBER and TUMBLING BAY, in the Metropolitan Borough of Stepney, in the Administrative County of London.

Persons desiring to submit Tenders may obtain the drawing, specification, form of Tender, &c., on application on or after Monday, 7th July, to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £5 by cheque or draft to the order of the London County Council. This amount shall be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained upon personal application, and the contract documents may be inspected at the Old County Hall before the payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 28th July, 1924, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
6435 Clerk of the London County Council.

Siam State Railways.
NOTICE.

TENDERS are INVITED for the SUPPLY of WHEELS and AXLES.

Specifications and drawings may be obtained against payment of £1 from Messrs. C. F. Sandberg, 40, Grosvenor-gardens, London, S.W. 1.

Sealed Tenders, with the inscription "Tender for the Supply of Wheels and Axles, B.E. 2467," must be forwarded to the undersigned, at whose office in Bangkok, Siam, they will be received up to Fourteen o'clock on the 31st October, 1924, at which place and hour the Tenders will be publicly opened and read.

Right is reserved to reject any or all Tenders and to accept any Tender which, in the opinion of the undersigned, is to the best interests of the Siam State Railways.

Department of State Railways, Bangkok,
17th June, 1924. 6437
(Sgnd.) ACTING COMMISSIONER GENERAL

Urban District Council of Teddington.
AIR COMPRESSING PLANT.

The Council invite TENDERS for the SUPPLY, ERECTION and SETTING TO WORK of TWO SETS of HORIZONTAL COMPOUND, STEAM-DRIVEN AIR COMPRESSORS, at their Sewage Disposal Works in Broom-road, Teddington.

Each set of compressors to be capable of compressing 300 cubic feet of free air per minute to a pressure of 14 lb. per square inch above atmosphere.

Copies of the drawings and specification may be obtained on application to Mr. Marshall Hainsworth, Surveyor, Public Offices, Teddington, accompanied by a crossed cheque for £5, payable to the Council, which deposit will be returned upon the receipt of a bona fide Tender.

Sealed Tenders and other details described in the specification to be delivered to the undersigned on or before Thursday, the 31st instant.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
G. H. SALMONS,
Clerk to the Council.
Council Offices,
Teddington,
2nd July, 1924. 6396

PUBLIC NOTICES

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of:—

1. FOUNDRY COKE.
2. WORKSHOP for PEROK and KALLAYI BRIDGES.
3. STRUCTURAL STEEL WORK (Underframe Shop).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Foundry Coke," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 1st August, 1924, in respect of Specifications Nos. 1 and 2, and the 19th September, 1924, in respect of Specification No. 3.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of:—

5s. for each copy of Specifications Nos. 1 and 2.
£1 for each copy of Specification No. 3.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
15th July, 1924.
91, Petty France, S.W. 1. 6420

In the High Court of Justice (Companies Winding Up).

To be Offered for Sale by TENDER, pursuant to an Order of the Registrar Companies (Winding Up), made in the matter of ALLEN and SIMMONDS (READING), Ltd., Branch Nameless, Ltd., v. Allen and Simmonds (Reading), Ltd., 1923 A., No. 2566, either in ONE LOT as a GOING CONCERN or in the following LOTS:—

LOT 1.

(a) A FREEHOLD GARAGE, SHOWROOMS and OFFICES, situate in the centre of READING, with frontages to Friar-street and Station-road, and containing an area of about 23,000 square feet, together with the ASSETS and the BUSINESS carried on on such premises, and the whole of the SHARE CAPITAL and DEBENTURES in GREAT WESTERN MOTORS, Ltd.

(b) A BLOCK of TEN FREEHOLD COTTAGES adjoining the above.

(c) A FREEHOLD FACTORY at Vastern-road, READING, with Modern Buildings thereon, covering an area of about 14,500 square feet, at present let as a Motor Body Building Works, in connection with the aforesaid business.

LOT 2.

(a) A LEASEHOLD ENGINEERING WORKS at READING, containing a total floor space of about 27,000 square feet, held for an unexpired term of 67 years at ground rents amounting to £77 6s. per annum. These Works are equipped with high-class ENGINEERS' MACHINE TOOLS for the manufacture of Piston Rings and other Specialities of the Company.

(b) THIRTY LEASEHOLD COTTAGES and a RESIDENCE adjoining, held for a similar period at nominal ground rents.

(c) LEASEHOLD PREMISES, suitable for Garages, situate No. 107, Caversham-road, READING, held for an unexpired term of 61 years.

(d) A FREEHOLD PROPERTY on the THAMES at CAVERSHAM, adjoining the Bridge, formerly a Club, but now let off in self-contained Flats.

(e) A FREEHOLD HOUSE, No. 13, King's Meadow-road, READING.

(f) The GOODWILL of the BUSINESS of ALLEN and SIMMONDS (READING), Ltd., as a GOING CONCERN and LETTERS PATENT for "Improvements in the Manufacture of Piston Rings, &c."

LOT 3.

3000 £1 FULLY PAID SHARES, GREAT WESTERN HOTEL (READING), Ltd.
25 £1 FULLY PAID DEFERRED ORDINARY SHARES, and
1500 £1 FULLY PAID PARTICIPATING PREFERRED ORDINARY SHARES in the READING FOUNDRY CO., Ltd.

Tenders, which must be on the form contained in the particulars, are to be sent to the Registrar, Companies (Winding Up), Room 48, Bankruptcy-buildings, Carey-street, W.C. 1, and marked "Tender re Allen and Simmonds (Reading), Ltd.," and delivered under seal by Twelve Noon on or before Saturday, 19th July, 1924.

Particulars, with plan, form of Tender, and conditions of sale, may be had of Messrs. W. B. PEAT and CO., Chartered Accountants, 11, Ironmonger-lane, London, E.C. 2; Messrs. WILDE, WIGSTON and SAPTE, Solicitors, 24, College-hill, London, E.C. 4; and of Messrs. PEACOCK and GODDARD, of 2, South-square, Gray's Inn, London, W.C. 1. 6046

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PUBLIC NOTICES

PUBLIC HEALTH ACT, 1875.

Rural District of Wallingford,
BERKSHIRE.
DIDCOT SEWAGE WORKS.

The Rural District Council of Wallingford, acting as the Sanitary Authority for the said District, are prepared to receive TENDERS for certain PLANT for the Didcot Outfall Works, as follows:—

CONTRACT NO. 2.—OIL ENGINES AND PUMPS.
CONTRACT NO. 3.—DISTRIBUTORS FOR FILTERS.

Particulars and specifications may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from July 21st, 1924, until August 4th, 1924, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of One Guinea, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract deed and bond, the draft of which may be seen at the offices of the Consulting Engineers when the drawings are inspected.

Tenders must be on the official form, each Tender in a sealed envelope, marked "Tender for Contract No. 2" or "Tender for Contract No. 3."

Tenders must be accompanied by the general conditions and specifications as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on August 11th, 1924.

Given under my hand the 14th day of July, 1924.

P. C. A. SLADE,
Clerk to the Rural District Council.

7, St. Martin's-street,
Wallingford, Berks. 6428

Bombay, Baroda, and Central
INDIA RAILWAY.
1 SENIOR AND 2 JUNIOR SIGNAL ENGINEERS.

The Directors are prepared to receive APPLICATIONS (by letter only) from properly qualified candidates for APPOINTMENT in the Construction Department of the Company in India:—

1 SENIOR SIGNAL ENGINEER.

QUALIFICATIONS.—Candidates should be between the ages of 25 to 30 years and are had a public school or good secondary school education, and a technical education in mechanical and electrical engineering at a recognised Engineering College. They should have a thorough knowledge of modern mechanical and power railway signalling practice, including the preparation of signalling schemes, installation and maintenance of same, and also training in signalling workshop practice. Preference will be given to candidates having a thorough knowledge of electrical signalling and interlocking, including D.C. and A.C. track circuit systems, automatic signalling, single and double line lock and block instruments, and other block telegraph and telephone apparatus used in modern signalling and the operation of railways.

Commencing salary Rs. 700 per calendar month.

2 JUNIOR SIGNAL ENGINEERS.

QUALIFICATIONS.—Candidates should have had similar training to that detailed above.

Commencing salary Rs. 450 per calendar month.

TERMS.—A three years' agreement in the first instance, with first-class free passage to India and home again on satisfactory termination of service.

The selected candidates will only be appointed subject to their passing a strict medical examination by the Company's Consulting Physician.

All applicants must state their age and whether married or single, with particulars of their training and subsequent experience, giving the names of firms by whom they have been employed, with dates in each case, and also whether they have been employed abroad before, and, if so, with particulars.

Letters of application, which should be accompanied by copies only of testimonials, &c., must be addressed to the undersigned not later than the 31st July, 1924.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1.
15th July, 1924. 6434

City of Birmingham Water
DEPARTMENT.

DRAUGHTSMAN REQUIRED TEMPORARILY for work in connection with Reservoir with earthen embankments.

Must be thoroughly experienced in design of waterworks, pipe lines, valve houses, reinforced concrete, &c. Salary Seven Guineas per week.

To reside at Ludlow.

Applications, endorsed "Draughtsman," stating age, experience, &c., with copies of two recent testimonials, should be sent to the SECRETARY, Water Department, Council House, Birmingham, on or before 30th July, 1924. 6443

Staffordshire, Wolverhampton
AND DUDLEY JOINT COMMITTEE FOR TUBERCULOSIS.
FRESTWOOD HOUSE SANATORIUM, NEAR STOURBRIDGE.

The Joint Committee invite APPLICATIONS for the POST of RESIDENT WORKING ENGINEER at the above Institution, to take charge of the Electric Lighting Plant, the Hot Water and Steam Heating Boilers, Laundry Machinery and Domestic Hot and Cold Water Supplies. The man appointed must be able to carry out usual repairs and be responsible for the efficient working of the whole installation.

A house will be provided, rent free.

Salary £3 10s. per week, rising to £4 per week after 12 months' service.

Applicants to state whether married or single, age and experience, and forward written application, accompanied by copies of three recent testimonials, to the undersigned not later than by first post on 25th July, 1924.

EUSTACE JOY,
Clerk to the Joint Committee.
County Buildings, Stafford,
14th July, 1924. 6418

SITUATIONS OPEN

WANTED by Well-known Engineers in the North, WORKS MANAGER; knowledge of Gearing essential. State qualifications and salary required.—Address, 6370, The Engineer Office. 6370 A

WANTED, CHIEF ENGINEER and DRAUGHTSMAN for old-established Gas and Chemical Engineers in North of England. Must be good practical as well as theoretical engineer. Permanent position for good man. State age, salary, and full particulars.—Address, 6350, The Engineer Office. 6350 A

WANTED.—Good FITTER and MACHINIST REQUIRED for General Engineers' Shop in East End of London. Man used to Steam and Electric Crane Repairs preferred. Constant work for suitable trade union man. Apply by letter, giving reference as to ability.—Address, P9352, The Engineer Office. P9352 A

WANTED by a Leading Boiler Insurance Company, additional BOILER INSPECTORS. Applicants must be practical engineers with a technical training, holding a first-class or extra first-class Board of Trade certificate, capable of making accurately dimensioned sketches of all classes of steam boilers, and writing clear reports on condition. Commencing salary £260 per annum.—Address, 6415, The Engineer Office. 6415 A

CONSTRUCTIONAL ENGINEERS REQUIRE REPRESENTATIVE, to deal principally with export markets. Only those with suitable connections need apply, stating experience and terms.—Address, "EXPORT" Wm. Porteous and Co., Glasgow. P9361 A

Messrs. SCHWEGLER BROS., WATTWIL (Switzerland),
Manufacturers of the
"HELVETICA" BALL BEARINGS,
are open to engage firm of good standing, and with good trade connection, for the sale of their speciality in Great Britain.

SITUATIONS OPEN (continued)

ENGINEER REQUIRED; Must be Thoroughly experienced in designing Aerial Ropeways. Salary £700 per annum.—Address full details, experience, age, &c., 6425, The Engineer Office. 6425 A

MAINTENANCE ENGINEER WANTED in Midlands Factory. Must be experienced in Hydraulic and Electrical Plants, thoroughly practical and not afraid of work. Give full particulars, age, and salary required.—Address, P9349, The Engineer Office. P9349 A

PRINTERS' ENGINEER. — Experienced ENGINEER REQUIRED, to Take entire Charge of Mechanical and Electrical Maintenance Staff of large Printing and Binding Works at Aylesbury. Practical knowledge of Printing and Binding Machinery and experience in control of staff on urgent repair work essential.—Write, stating qualifications, age, and salary required, Mr. R. C. HAZELL, Hazell, Watson and Viney, Ltd., Aylesbury. 6394 A

REPRESENTATIVES WANTED, High-class Quality Soluble and Non-soluble Metal Cutting Oils and Core Oils. Only capable men already calling on engineers, foundries, &c., need apply. Good proposition, commission basis. State age, territory, and lines handled.—Address, P9363, The Engineer Office. P9363 A

STRUCTURAL ENGINEERS REQUIRE CHIEF DRAUGHTSMAN for their Estimating Department accustomed to control of staff and good organiser; must be well versed in modern design of Light Steel-framed Buildings. State experience, salary required.—Address, "STRUCTURAL," Wm. Porteous and Co., Advertising Agents, Glasgow. P9347 A

WELL-KNOWN FIRM, Manufacturing Plant and equipment for civil engineering works, REQUIRE the SERVICES of an ENGINEER to represent them in India. Applicant must be unmarried and under 35 years of age, and will be required to spend 12 months in England to get a thorough knowledge of the business and afterwards proceed to India for 4 years. First-class passage out and home and 6 months' leave on half pay on the completion of the engagement. Send full particulars, experience, and salary required.—Address, 6405, The Engineer Office. 6405 A

WANTED for Large Locomotive Works, Experienced DRAUGHTSMAN, accustomed to making designs and taking out weights for estimating purposes.—Address in confidence, stating age, experience, and wages required, 6412, The Engineer Office. 6412 A

CONSTRUCTIONAL STEEL WORK DRAUGHTSMAN REQUIRED for Designing Department in London.—First-class man, well up in sizes and good knowledge of the design of Light Construction. State experience and salary required.—Address, P9341, The Engineer Office. P9341 A

DRAUGHTSMAN WANTED, a Second Charge Hand, Estimating Department; good experience in the design and calculations of Steel-framed Buildings for home and abroad. Salary £5 10s. weekly.—Address, "DESIGN," Wm. Porteous and Co., Glasgow. P9348 A

DRAUGHTSMAN WANTED for Liverpool; Knowledge of Compressor Design essential.—Address, 6440, The Engineer Office. 6440 A

DRAUGHTSMEN, with Previous Experience of Beam Coal Weaheries. APPLICATIONS are INVITED from draughtsmen with the above experience. Permanent position and good prospects for first-class man.—Apply by letter, giving full details of previous experience, stating age and salary required, to NORTONS (Tividale), Ltd., Tipton, Staffs. 6438 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

FORCED DRAUGHT FURNACE COMPANY, London, REQUIRE ENGINEER DRAUGHTSMAN, competent prepare designs and make boiler trials. Thorough knowledge of combustion essential.—Address, stating age, experience, and salary, 6448, The Engineer Office. 6448 A

LEADING DRAUGHTSMAN REQUIRED. Thoroughly experienced in Lift Lay-out and Details. Midland area.—Address, stating age, experience, and salary required, 6307, The Engineer Office. 6307 A

MECHANICAL DRAUGHTSMAN WANTED for Ships' Deck Machinery; only those experienced in Electrical Gear Need apply. State age, experience, and salary required.—Address, 6408, The Engineer Office. 6408 A

PUMPING MACHINERY. — DRAUGHTSMAN WANTED, capable of designing and calculating. State experience, age, and salary required.—Address 6022, The Engineer Office. 6022 A

SEVERAL DRAUGHTSMEN REQUIRED, Having first-class experience of Belt Conveyors. Preference given to those having structural experience.—Replies by letter only, stating experience in full detail and salary expected, to STOTHERT and PITT, Limited, Bath. 6428 A

WANTED, FOREMAN CARPENTER for Large Contract abroad (British Colony). Must have had special experience of scaffolding and the erection of falsework staging and high towers for cranes; no others can be considered. Contract will extend over several years. Written applications, stating age, experience, and salary expected, with testimonials, to be forwarded.—Address, 6442, The Engineer Office. 6442 A

WANTED IMMEDIATELY, 3 Thoroughly Competent BOILERSMITHS, accustomed Traction Engine and Steam Roller Repairs. Must be able make and fit new fire-box. None but thoroughly competent men need apply.—Address, 6390, The Engineer Office. 6390 A

WANTED IMMEDIATELY, 3 Thoroughly Competent FITTERS or IMPROVERS, accustomed Traction Engine and Steam Roller Repairs. None but thoroughly competent men need apply.—Address, 6400, The Engineer Office. 6400 A

SITUATIONS WANTED

A CIVIL ENGINEER, Who Has Lately Held Positions as advisory purchasing engineer for machinery, plant and material on important Government and other works, is DESIROUS of OBTAINING an APPOINTMENT; thorough knowledge, unexceptional references.—Address, P9362, The Engineer Office. P9362 B

ADVERTISER (40), Skilled Mechanic, SEEKS SITUATION; life experience, good all-round man, experimental, light mechanical work, electrical experience, excellent references; London district preferred.—Address, P9344, The Engineer Office. P9344 B

COMMERCIAL and TECHNICAL ENGINEER, Age 40, M.I. Mech. E., wide managerial experience with well-known progressive companies, DESIRES responsible APPOINTMENT. Highest references. Could invest moderate amount in sound business offering employment.—Address, P9356, The Engineer Office. P9356 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Home of James Watt.

ONE of the most pleasing features of the World Power Conference was the appointment of a committee, international in character, to take steps to raise a fund for the purchase of Heathfield Hall, near Birmingham, the well-known home of James Watt, which is about to be offered for sale. It was thought that it would be a graceful act on the part of those attending the Conference to undertake the responsibility of purchasing the home of the great engineer and of maintaining it unaltered as a place of pilgrimage for the present and future generations. The committee has been authorised to ascertain the price at which Heathfield Hall can be acquired, and if the purchase is carried out, to form a local or national committee under whose control the building would remain.

Approaching Completion of Cruisers.

THE last of the light cruisers laid down under the war programme, which have continued to provide the dockyards with work ever since the Armistice, will be completed in the course of next year, according to a report published early in the week. Of these ships, the Frobisher, which was begun at Devonport as far back as August, 1916, is being prepared for service in the Mediterranean. A sister vessel, the Effingham, is to be ready for sea next March, when she is likely to be commissioned as flagship on the East Indies Station in place of the Chatham, now becoming obsolete. The Frobisher and Effingham belong to the "Improved Birmingham" class, which comprises four of the most powerful cruisers at present afloat. They are ships displacing nearly 10,000 tons, capable of steaming at 31 knots, and mounting the formidable armament of seven 7.5in. guns. Next March will also witness the completion of the Emerald, a cruiser of 7600 tons, with machinery of 80,000 shaft horsepower for a speed of 33 knots. Her battery consists of seven 6in. guns. Finally, in July, 1925, the Enterprise, of the same class, is to hoist the pennant. Both ships will probably join the Effingham on the East Indies Station, thus forming a squadron of remarkable speed and fighting power. Owing to the want of large ocean-going cruisers, the Admiralty has been compelled so far to utilise small ships of the "C" and "D" class for foreign service, though, never having been designed for such work, they are lacking in the accommodation which is required to maintain the health and comfort of the *personnel* in tropical climates. Their presence on the foreign stations, and the hardship it entails to their officers and men, is a direct result of the drastic "cuts" which have been made in the naval budget during recent years.

Waterloo Bridge.

REOPENED for foot passengers about a fortnight ago, Waterloo Bridge, relieved of some of its superincumbent weight, was brought back still further into service on Monday, when vehicles of less than 10 tons in weight were given permission to cross it at speeds not in excess of 3 miles an hour. Until the temporary bridge to be erected is ready, this limited use of the structure will certainly relieve some of the congestion on the other bridges that cross the Thames. It seems patent that if final relief is to be secured, the bridge will have to be widened during the reconstruction process, in accordance with the London County Council's announced intention. There are some, however, who view this scheme with disfavour. The Society for the Protection of Ancient Buildings is, for instance, against it, and on the strength of a report submitted to it by an engineer, has urged the County Council to leave the bridge as it is, merely replacing the existing timber foundations with concrete and brickwork. The Society argues that modern engineering methods would permit the concrete to be placed in position under the piers without disturbing a single stone of the structure. With that view, Mr. Basil Mott and Sir Maurice Fitzmaurice, who are advising the Council in the matter of the bridge, cannot agree. These engineers hold the opinion that the underpinning of the existing piers would not remedy the defects, but would seriously increase them, and would involve a grave risk to the old structure.

Tramway Car and Omnibus.

THE Highways Committee of the London County Council has been considering for some time past the merits of municipally operated omnibuses and trackless cars, as compared with its own system of tramways. Summarising the information received from provincial centres, the tramway manager has reported to the Committee that the advantage lies with the tramway car in the matter of seating accommodation, speed, acceleration and deceleration, freedom from side skidding, cost of operation per seat-mile, wear and tear on the roadway and ability to operate in foggy or snowy weather. Only in the matter of flexibility is anything conceded to the omnibus, and even in this respect it is added that the flexibility of the omnibus is least available when it is most required. Indeed, after reading the report, one wonders how omnibuses generally manage to pay at all, and why most tramways, and especially the London system, do not. The Committee, while suggesting that the trackless car as an extension of existing tramway systems, deserves close study, does not see much opportunity of employing it in the London area.

Oil Waste in Navigable Waters.

ALTHOUGH the Oil in Navigable Waters Act of 1922, by prohibiting the discharge of oil waste from ships' bilges and tanks within the territorial waters of this country, has done much to diminish the nuisance and harm that were being caused round our coasts, the trouble has not yet been overcome. It seems doubtful whether it will be surmounted without international control over the matter. In this connection, we notice that an Act has been passed in the United States which, like our own, prohibits the discharge of oil waste in the coastal navigable waters of that country. It may be recalled that the International Shipping Conference appointed a Committee to consider the question of oil discharge on an international basis. The Chamber of Shipping of the United Kingdom is now preparing the way for the International Committee. It has appointed a Committee of experts to investigate the extent of the pollution, where it arises and how it can be cured, and is appealing to all concerned to contribute constructively to the investigation of the subject.

Wireless Communication.

ON Monday evening last a short talk on the future of "wireless" by Professor Elihu Thomson was broadcast from the London station of the British Broadcasting Company. Professor Thomson referred to the great educational value of broadcasting and to various technical problems associated with the subject which remain to be solved. He also referred among other things to the rapid progress of broadcasting in America; but it is a pity, we think, that he failed to realise that to a very large extent he was addressing a non-technical audience, with little, if any, knowledge of the technical terms that are used in America. How many users of receiving sets in this country, we wonder, are aware that in America a valve is called a tube and a frame aerial a loop? We doubt, in fact, if many know that another name for the aerial is the antennæ. The speaker's references to tubes and loops must have puzzled many listeners more than enough, and it is a pity Professor Thomson did not adopt the terms that are familiar to the British public.

Electricity on the Farm.

A FEW days ago we were invited by Mr. Borlase Matthews to inspect his electrically operated farm at East Grinstead. Mr. Matthews has undoubtedly paid more attention to the application of electricity to agriculture than any other engineer in this country. On his farm he uses electricity for many purposes, and he finds that electrical operation pays. Electrically heated incubators, for instance, have proved to be very profitable. Electric ploughing is also carried out on Mr. Matthew's farm, with highly satisfactory results; whilst on the dairy side electricity is used for milking the cows. The many uses to which electricity may be put in connection with farming were described some time ago in a paper read by Mr. Matthews before the Institution of Electrical Engineers. He also read an interesting paper on the subject at the World Power Conference, and a few brief notes from this paper are published elsewhere in this issue. Future progress in this direction naturally depends upon the provision of cheap electricity supplies in the rural districts, and it is to be hoped that before many years are past these supplies will be available.

The Whitworth Society.

THE Whitworth Society, composed of Whitworth scholars, exhibitioners and prizemen, is now in its second year of existence. Its first President, Dr. Hele Shaw, a Whitworth scholar of the year 1876, was largely responsible for its formation. He has now vacated the chair, and has been succeeded by Mr. R. B. Buckley, who is believed to be the oldest surviving Whitworth scholar. Mr. Buckley obtained his scholarship in 1869, the year after the scheme had been founded by Sir Joseph Whitworth. The Society is endeavouring to attract to its membership an increased number of those who have obtained scholarships, exhibitions and prizes within recent times, and under the capable supervision of Professor D. A. Low, is collecting for publication the names and professional histories of all its members. It intends to hold its second annual dinner in London on December 21st, the one hundred and twentieth anniversary of Whitworth's birth.

Coal and Power.

THE report, published last Saturday, of the committee which, under the presidency of Mr. Lloyd George, has been inquiring into the conditions of the coal industry and the use of power, visualises a very wide range of reform and touches the nation's industrial activities at many points. It recommends the purchase of all minerals and royalties by the State and their administration by a body of non-political commissioners which, among other duties, would endeavour to secure the amalgamation and grouping of mines and would insist upon adequate housing accommodation for the miners being provided as a condition of leases to mine coal. With the reorganisation of the mining industry the committee links a reorganisation in the electricity supply industry. It recommends that the Electricity Commissioners should be given power to enable them, with the aid of private enterprise, to establish a national system of electrical generation and distribution. Through the Commissioners the State should be given power to lay trunk mains in special circumstances, and to remove vested electricity interests, if they stand in the way of public interests, by compulsory acquisition. In this connection the report lays particular stress on the acquisition of all necessary water rights. The national electricity supply and transmission system should, it is urged, be designed and developed to encourage the conservation of fuel, the utilisation of by-products, and the development of new industries, particularly in rural districts.

The Kelvin Centenary.

WILLIAM THOMSON was born in Belfast on June 26th, 1824, and in ordinary circumstances his centenary would have been celebrated on June 26th of this year. In view, however, of the fact that many illustrious visitors from the overseas countries of the British Empire and from foreign lands would be present at the World Power Conference, it was decided to postpone the celebration to allow them to participate. The celebration, therefore, took place last week, when the Kelvin oration was pronounced by Sir J. J. Thomson in the Great Hall of the Institution of Civil Engineers, before a very large company. On the same occasion the Kelvin medal was presented to Professor Elihu Thomson by Sir Charles Morgan, President of the Institution of Civil Engineers. The medal was established in 1914, and is awarded triennially, the first recipient being Dr. Cawthorne Unwin. Immediately after the presentation of the medal Sir Richard Glazebrook, representing the Royal Society, took the chair and received written addresses from the numerous delegates who attended the celebration. On the same evening the Royal Society held a soirée at Burlington House in honour of Lord Kelvin, and on Friday evening a banquet in his honour was given at the Connaught Rooms. Lord Balfour occupied the chair, and pronounced a memorable address, in which he said that Kelvin would take his place amongst the Immortals of Science. The future would look back on him as the founder of that sure knowledge of the fabric of the world on which must be based most of our hopes for the material advance of humanity.

Power Scheme for New Zealand.

IT was announced in Wellington, New Zealand, on Friday of last week, that the contract for the dam, spillway, headworks and power-house of the New Zealand Government's scheme for the development of electric power at Arapuni had been given to Sir W. G. Armstrong, Whitworth and Co., Limited, at a price of £1,175,652. It is too soon yet to give any detailed account of the proposed plant, but we are informed by the contractors that the power-house will primarily be equipped with three turbine sets of 25,000 horse-power each, working under a head of 175ft. and generating three-phase current at 6600 volts. The current will be stepped up possibly to 66,000 volts for distribution by several feeders. The head works will require the tunnelling of a mountain and will include three penstocks 12ft. in diameter.

Railway Accidents in 1923.

OWING to the reduction, by grouping, of the number of railways, and to the omission of the Irish railways, which are no longer under the supervision of the Ministry of Transport, seven columns in all suffice for the annual returns of British railway accidents in 1923, which have just been issued. As a result, it has been possible to make several small but useful improvements in the returns. For example, figures are now given for four years preceding the year of issue instead of for one only. Another useful modification is the subdivision of the twenty-six headings under which the various classes of accidents are recorded. Formerly if it was desired to know how many tires, axles, couplings and rails had failed on each railway, the return was useless because the figures were given *en bloc* for the whole country, and even then only as a footnote. Now the figures are given separately. Altogether the new tables show a great improvement, and the Ministry of Transport deserves commendation for the changes effected. The figures for last year differ very little from those of other recent years, and we find, with one exception, nothing to which to draw attention. The exception is the continued reduction in the number of fatal movement accidents, *i.e.*, accidents caused by the movement of vehicles. In 1923 there were only 201 such accidents—the lowest on record. Twenty and more years ago these fatal accidents reached a total of over 400.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XIII.*

THE SOUTH AFRICAN AND RHODESIAN EXHIBITS.

AT the British Empire Exhibition the Union of South Africa and Rhodesia share a single large building, which if not so imposing as the Canadian or so notable as the Australian sections, contains nevertheless many fine exhibits, and among them several which are of direct, and many more which are of indirect, interest to engineers.

General Smuts, in his preface to the official catalogue, complains that while South Africa is frequently in the forefront of Empire politics, it is after all the least known of all the great British Possessions except to those people who inhabit it or are directly concerned with it. If such a statement is accurate, the man who has been wont to regard these two great territories as merely the places where gold and diamonds and ostrich feathers come from, has a great object lesson in these exhibits, which will teach him that there are many other things which are useful and of importance in the way of local products which are worthy of his attention.

The British mining engineer and the manufacturer of mining plant have long looked upon South Africa in spite of its many vicissitudes, as one of their most prolific and satisfactory of hunting grounds, and in a minor degree, the railway, the harbour, the electrical, the irrigation and the agricultural engineer have followed them. But there are many things which cannot fail to strike the visitor to these two well-organised sections, especially if he takes the trouble to provide himself with the excellent literature that is obtainable there. The first fact he will observe is that, vast as is the production of gold and diamonds, and whilst the output of coal and other minerals is growing steadily, the mining potentialities of South Africa and of Rhodesia are so immense as to be as yet scarcely touched. From time to time we hear of the eventual exhaustion of the Rand mines and yet their output goes on without diminution. But, extraordinary as it may seem, a visit to this Exhibition shows that it would not matter much to South Africa if some day these mines did stop, for the unworked propositions that are already known would far more than compensate for the exhausting of all existing mines.

The second great lesson taught by the South African and Rhodesian sections is that while in the past these two territories, apart from their gold and diamonds, were worked purely for home supplies, to-day South Africa, at all events, is competing seriously with Canada, Australia and South America, as one of the great food purveyors of the world. The enormous importance of this fact to the engineer needs no emphasising. Unlike Canada, who makes much of the plant that she requires for the development of her industrial resources, and Australia, who is following in Canada's footsteps to some extent in this respect, South Africa and Rhodesia at present and for many years to come must purchase practically all such plant from the outside world. It is for this reason that there is very little to be seen of locally made machinery in the South African and Rhodesian sections, for, although there are many engineering works out there and some quite large works, they are mainly employed in repairs and renewals to keep the mines and railways going and in satisfying emergency demands for parts or, in some cases, for whole machines.

SOUTH AFRICAN MINING SECTION.

Particularly is the Union Government to be congratulated on the thoroughness with which it has organised its mining exhibits. Not only have we here, as in the other Dominions, a comprehensive display of the whole of the mineral products to be found in the Union, but we are able, by means of a series of specially prepared maps, to locate easily every known mineral product that exists in this vast country. The position of all the formations containing gold, diamonds, copper, lead, tin, fluorspar, nickel, platinum, antimony, chromium, germanite, molybdenum, iron, vanadium, talc, gypsum, graphite, magnesite, manganese, mica, corundum, asbestos, kieselghur, many sorts of building and other stones, oil shales and coal, are marked on these maps, and specimens of each, including a huge cube of the famous Kimberley "blue ground," which is responsible for most of the diamonds of the world to-day, and a full size replica of the famous Cullinan diamond, are shown.

The mining engineer and the geologist who wish to make a real study of South African minerals, will find here in a condensed form an opportunity which may never occur again of seeing under one roof very nearly everything that he wants to see in this connection. We point this out because, unless his visit is in the morning before the dense crowds arrive, he may well pass through this building without realising the actual and potential mineral wealth of South Africa or even without finding many of the most interesting of the things he would like to see.

Here, as elsewhere throughout the Exhibition, the practical and immense value of exhibiting machinery in motion is very clearly demonstrated. There are but two of these exhibits, but from the popular and to a great extent from the practical standpoints, they prove themselves to be by far the most attractive feature in this building. They are the diamond washing plant erected and exhibited by the Diamond Producers' Union of South Africa, and the diamond cutting machinery shown by Messrs. M. Van Moppes and Sons, of London.

The diamond washing plant which is very well displayed, consists of a diamond "jig," which forms the "concentrates," and the "grease table," which extracts the diamonds from the rest of the concentrates. There is nothing strikingly novel in either of these machines, but there must be many thousands of engineers, whose paths lie in other directions, who have never seen a diamond washing plant in operation, and the exhibit affords them an excellent opportunity for so doing. Its extraordinary simplicity, its autonomy and the totally "unskilled" nature of the process make up its charm. Into the "jig" the disintegrated blue ground is fed from the crushers, and the whole of it is forced to travel from one end of the jig to the other. During the process it is subjected to water pulsations produced by a plunger working in a separate cylinder. As the stuff travels across the jig, the mass being temporarily disturbed by the water pulsations, the heavier deposits gradually find their way by gravity down to the bottom of the jig, whence they are extracted in the form of "concentrates." The concentrates include *all* the diamonds that are in the jig, as their specific gravity is higher than that of most of the other constituents of the surrounding earth. The concentrates, therefore, are composed of diamonds and such other fragments of the earth as are of equal or greater specific gravity.

The concentrates are fed with water flowing through them on to the "grease table," which is merely an inclined and vibrating "water chute," the upper surface of which is smeared with grease. Diamonds, having an affinity for grease, are at once arrested and stick to the plate when they come in contact with the grease, while the worthless portion of the concentrates is carried on by the flow of water until the fragments fall on to a conveyor which takes them to the dump.

Equally interesting but of a very different nature are the diamond-cutting machines, where the operations of cutting, turning, trueing and slitting the stones, as also the grinding and polishing of the facets, are all demonstrated on minute but highly scientifically made machines. In all these operations the cutting agent is the finest of diamond powder produced from "bort," i.e., stones that are useful only for industrial purposes. The most strikingly interesting of all these processes is the sawing or slitting of the diamond by means of a circular "saw," perhaps an inch and a-half in diameter. This "saw" is in reality a disc made of phosphor bronze and so thin and soft that one can readily crumple it up between the finger and thumb, and yet when its rim is impregnated with bort dust it will slowly forge its way through the hardest diamond. An experiment with this fragile tool shows that it will cut clean through the steel blade of a carpenter's plane without effort.

Apart from the cutting machines in operation there is shown a very complete range of diamond tools for use in all the industries for which such implements are now used, including diamond drills for water boring, tools for turning ebonite and vulcanite, trueing up abrasive wheels, wire drawing, engraving, splitting optical lenses, and glass and marble cutting.

An inspection of this stand leads to the impression that we are only at the beginning of a knowledge of the practical utility of the diamond as a cutter and grinding agent for engineering work. In this respect the limiting factor would seem to be not so much the cost of the cutting agent as the ill-effects of the diamond powder, which is the most pernicious of all dusts if it enters the lungs of the operator.

The nineteen colliery companies which are members of the Transvaal Coal Owners' Association, producing between them 6,500,000 tons per annum, have an interesting display of their products, including columns of coal representing typical seams and imposing panoramic views of their collieries.

SOUTH AFRICAN RAILWAYS.

The South African Railways have a representative display of their locomotive and rolling stock, mostly in model form. The striking impression conveyed by these models is the massive and bulky nature of the vehicles that can be run upon a 3ft. 6in. system, the rolling stock being quite as wide and sometimes wider than the usual standards for the British 4ft. 8½in. gauge. Some of the models shown represent engines which, with their tenders, measure 64ft. 5in. and 65ft. 7in. in length, with long wheel bases, and weighing 134 tons. The most notable model is a full size one showing the fore end of a locomotive emerging from the mouth of a tunnel. There is also the model of a bow-well twin-screw suction cutter hopper dredger used in harbour work and built by Ferguson Bros., of Glasgow.

Outside the building, and standing on its own 3ft. 6in. line of rails, is a complete *train-de-luxe* as used on the South African Railways, with an electric passenger and freight locomotive by the Metropolitan-Vickers Company, Limited, of the type 0–4 X 4–0, which weighs 66 tons. This engine has four motors each of 300 horse-power for 3000 volts, which develop a continuous tractive effort of 16,400 lb. at 23 miles per hour. The maximum speed is 45 miles. This is one of a series of 78 engines ordered by the South African Railways. The train is made up of a first-class main line coach 63ft. long and two dining cars each 60ft. long.

In striking contrast with this most modern representation of South African locomotion is an ancient and decrepit stage coach, a survival of the earliest days of the Kimberley diamond rush when, drawn by eight horses, it held the speed record before the introduction of railways.

SUNDRY SOUTH AFRICAN EXHIBITS.

The South African Iron and Steel Corporation of Pretoria is showing some iron manufactured locally from native ore. Wright, Boaz and Co., of Johannesburg, exhibit one of their "Robeson-Davidson" slimes pumps, in which the wearing surfaces inside the pump have a "white-iron" lining to protect the machined portions. The stuffing-boxes are kept clear of grit by the introduction to them of clean water under pressure. The Delfos Company, of Pretoria, exhibits rock drills and jack hammers and parts, and Mr. W. C. Lane has some anvils, &c. The Vereeniging Estates, Limited, have a really fine display of various steel products, which, however, from the point of view of the engineer, has been considerably spoilt by covering the whole of these materials, which must weigh many tons, with thick coatings of blue and silver paint, thus obscuring the quality of the steels. No doubt if we could see them properly we should find them good, and they comprise a huge steel trophy in the form of an arch composed of flat, round and square bars, rails, channels, angles, fish-plates, tube mill bars, fencing standards, and cast steel stamp battery shoes, dies and cams. This company is also showing fire and silica bricks, pipes and other earthenware used in engineering.

As is the case with the other Colonies, the aid of the cinema has been used to demonstrate the industrial life of South Africa, and there are many striking films showing the working of the mines, the railways, grain handling, irrigation work, and other industrial developments which are of equal importance to our manufacturers and go far to provide a remedy for the defective knowledge complained of by General Smuts, above referred to. Truly it will be the visitor's own fault if he leaves this section without having a better knowledge of South Africa's potentialities.

RHODESIAN EXHIBITS.

We now come to the Rhodesian section which, though naturally overshadowed by the display of the South African Union, is a really fine show and is representative of a very interesting unit of the Empire. Here, again, the mining section is naturally the most important. Roughly one may say after a general survey of the mineral specimens, that Rhodesia produces, though in far smaller quantities, very nearly all the minerals that are produced by her larger neighbour. As in the Transvaal so in Rhodesia gold is the staple product, accounting for no less than £57,522,241 out of the £69,659,932, which represent the total value of the mineral production of the country up to date.

An interesting model of the Globe and Phœnix Mine shows very clearly the formation of the reef, the levels and the winzes, and there is a good repre-

* No. XII. appeared. July 11th, 1924.

sentation of a vertical section of the famous coal seam at the Wankie Colliery. It is cut perpendicularly down one of the faces of the mine, and shows the great thickness and uniformity of the coal. In this connection it is interesting to note that the Wankie is by far the largest coal proposition in the world. Its reserves are said to amount to no less than six thousand million tons, or enough to keep the whole world going at the present consumption for a century or more.

Another mineral record held by Rhodesia is in chrome iron ore. Her production of this commodity exceeds that of any other country. Some day, too, Rhodesia may lead the world in the production of asbestos. At present she is second only to Canada in this respect.

The Rhodesian railways, which play so important

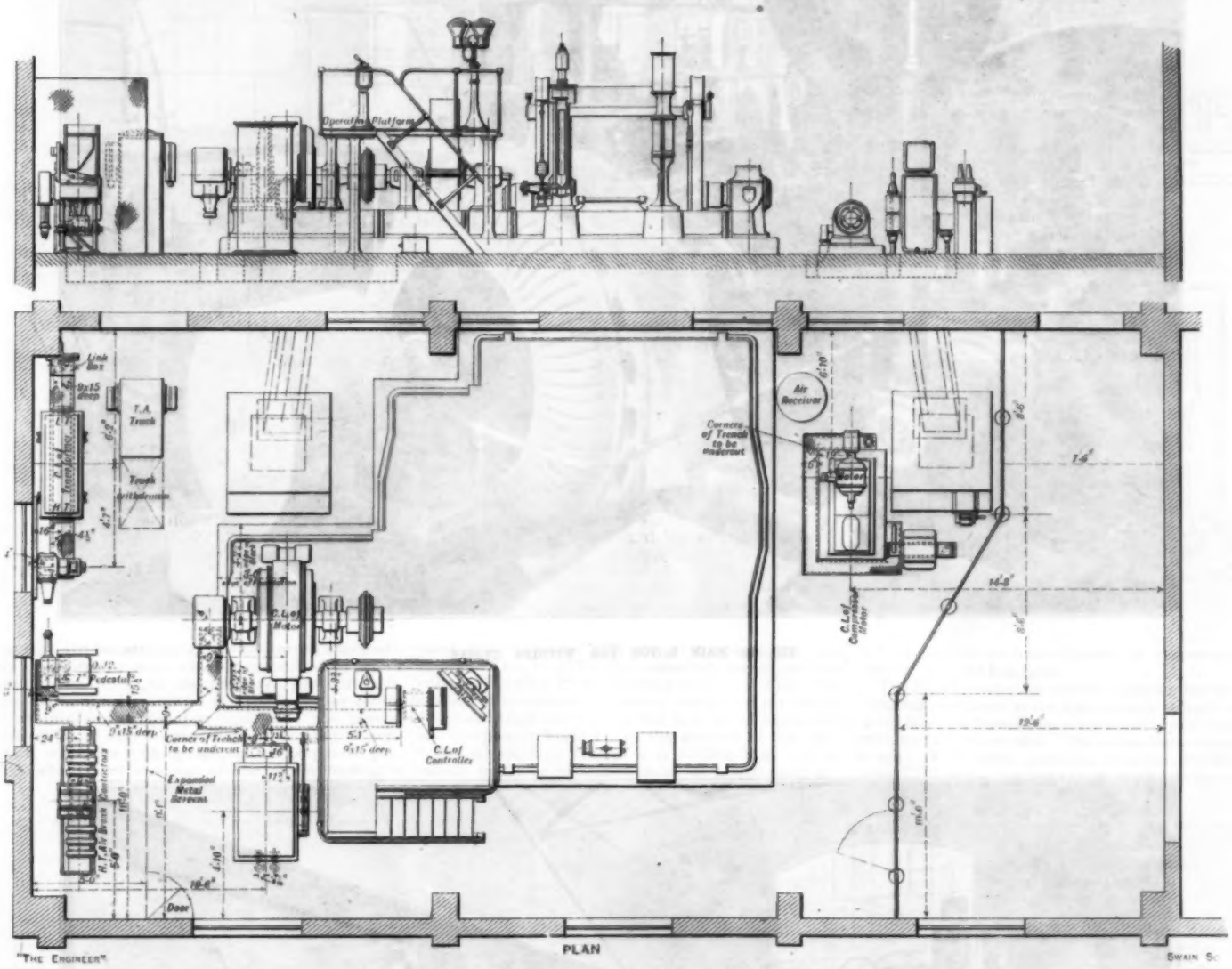


FIG. 261—ELECTRICAL WINDING PLANT FOR A COLLIERY—BRITISH THOMSON-HOUSTON

a *rôle* not only as a domestic problem but in the communication between the Southern Congo and South Africa, are represented only pictorially. We must bear in mind, however, that they are based entirely on those of the South African Union even to the types and dimensions of the locomotives and rolling stock.

When we consider the manner in which Rhodesia, owing to her geographical position, is handicapped as compared with all other parts of British-owned Africa, we can only say that the Exhibition affords a real tribute to the pluck and energy of the small community of white people who are responsible for her progress.

THE CITY OF DERBY'S EXHIBITS.

In any other spot but Wembley Park the "Civic Hall" would be accounted a big building, and even there, in that huge centre of competing attractions, it can hold its own as an interesting display, and, what is more, it is unique, for no other building except the Palace of Arts, and that only to a limited extent, is devoted to a series of different exhibitions. In turn the municipalities of different cities each occupy the whole of the Civic Hall for a few weeks. It did not find a tenant during the earlier period, but the following cities are exhibiting there in the order given: Bristol, Derby, Hull, Cardiff, Salford, Liverpool, and London. At the present time Hull is in possession, but at the time of our visit Derby was providing a display of great engineering interest.

In this building the ancient city of Derby set itself to show the Empire what it was in the beginning—and that beginning, industrially speaking, was very long ago—and to trace its gradual evolution from primitive but always productive methods up to to-day, when it claims to be a progressive engineering centre. Although much that was demonstrated belongs to a bygone day, the exhibits were full of historical interest, and one corner of the building might well have been nipped bodily out of the Palace of Engineering, for it was used by the more notable of the Derby engineering firms of to-day to display their latest wares.

Let us run briefly over that fascinating early history of engineering in Derby, which was portrayed partly by exhibits and partly by an elaborate frieze which encircled the main hall. It begins eighteen years before the advent of William the Conqueror, when Derby already possessed no less than fourteen water-power driven mills. In 1204 Derby was established firmly as a centre for weaving and dyeing, both to some extent by mechanical appliances, and was also producing articles in lead and leather. Jumping some five centuries during which steady progress continued, we come to 1702, when Derby led the way by installing the first silk mill in England, the machinery being made locally from designs by an Italian inventor. This mill employed some three hundred hands, at wages varying between 2s. and 3s. per week. It is on record that the owner died a very wealthy and much honoured man. In 1734 iron and copper smelting works and rolling mills were in full swing turning out, more particularly, quantities of copper sheathing for the war vessels of the period. Six years later Derby set itself seriously to the making of large clocks, and in the process greatly improved upon the mechanical movements used in the industry. It was also the birthplace of the "fireproof" cotton mill, the first to be erected in England being established there by a certain Jedediah Strutt, in 1775.

The first year of the following century saw the successful operation of cement works, a shot tower and a factory for making red and white leads, and in 1818 was established the "Britannia Foundry," which survives to-day and is owned by Handyside and Co.

All this tradition relating to the old-world engineering was depicted or recorded in the Derby Civic Hall at Wembley, but there was also a modern side which, if less picturesque and romantic, was equally interesting. A large section of the main hall was devoted to modern engineering productions. Here we found the machinery and other exhibits of the present-day engineering firms of Derby. For instance, there were refrigerating and ice-making plant by the Haslam Foundry Company; chains, conveyors and elevators by the Ewart Chainbelt Company; electrical generators, motors and other plant by Newton Bros.; pipe work for power stations by Aiton and Co.; a selection of malleable and steel alloy castings by Isaac Hill and Son; and electrical cable by the Macintosh Cable Company.

To the average overseas Briton, Manchester, Sheffield, Glasgow, Birmingham and Leeds are the great industrial and engineering centres in the home country, and Derby they are wont to consider as a place which grows, or did grow, expensive crockery. This compact, well arranged and carefully thought-out Civic Hall exhibit must have gone far to create an Empire-wide understanding not only of what Derby was but what she is as a factor in the engineering world.

ELECTRICAL ENGINEERING EXHIBITS.

THE MODEL COLLIERY.

The model colliery which was constructed under the auspices of the Mining Association of Great Britain is creating a considerable amount of interest, and the electrical winding equipment built and installed by the British Thomson-Houston Company, Limited, of Rugby, is one of the principal attractions Although the depth of the shaft is only 37ft., the electrical plant corresponds with that which the makers have supplied to large and important collieries in different parts of the country, and the design embodies all the latest improvements. The winding engine which lowers visitors into the mine, and which was built by Markham and Co., Ltd., of Chesterfield, is shown in Figs. 262 and 263, on page 66, and in the drawing Fig. 261. The 10ft. drum is driven through a single reduction gear with double helical teeth by a 500 horse-power B.T.H. 12-pole induction motor, supplied with three-phase 50-cycle current at a pressure of 3300 volts. In the design of this motor great care was taken to proportion the parts, so that the machine should be capable of withstanding the heavy duty which winding work entails. Particular attention was paid to the design of the rotor and its windings.

Referring to the diagram of connections, Fig. 264, connection to the supply is made by means of a triple-pole oil break switch of the ironclad draw-out pedestal type, which has three tripping devices which

EMPIRE EXHIBITION—MODEL COLLIERY ELECTRIC WINDING EQUIPMENT

THE BRITISH THOMSON-HOUSTON COMPANY, LTD., RUGBY, AND MARKHAM AND CO., LTD., CHESTERFIELD, ENGINEERS

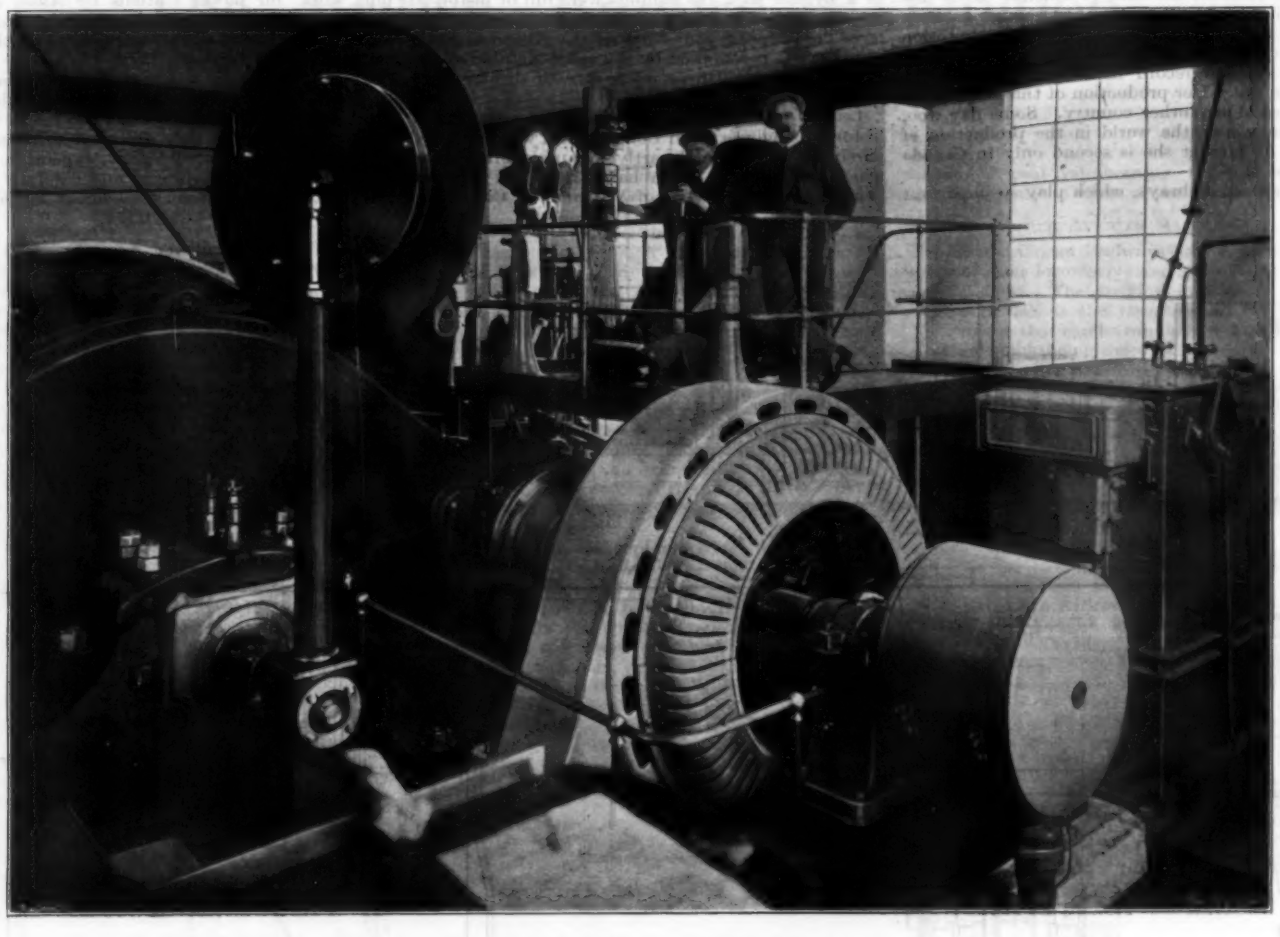


FIG. 262—MAIN MOTOR FOR WINDING ENGINE

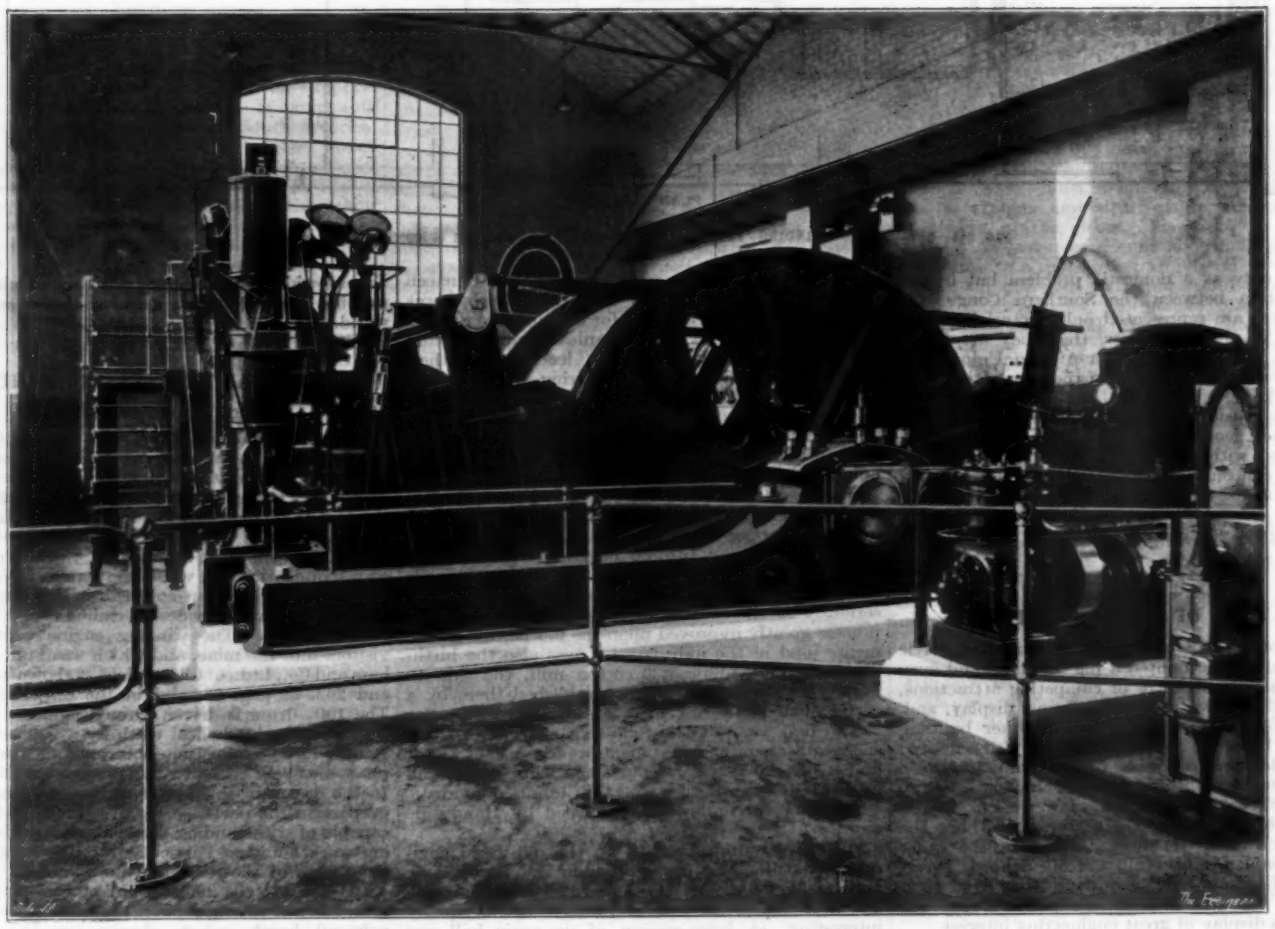


FIG. 263—THE WINDING ENGINE AND ELECTRICALLY-DRIVEN COMPRESSOR

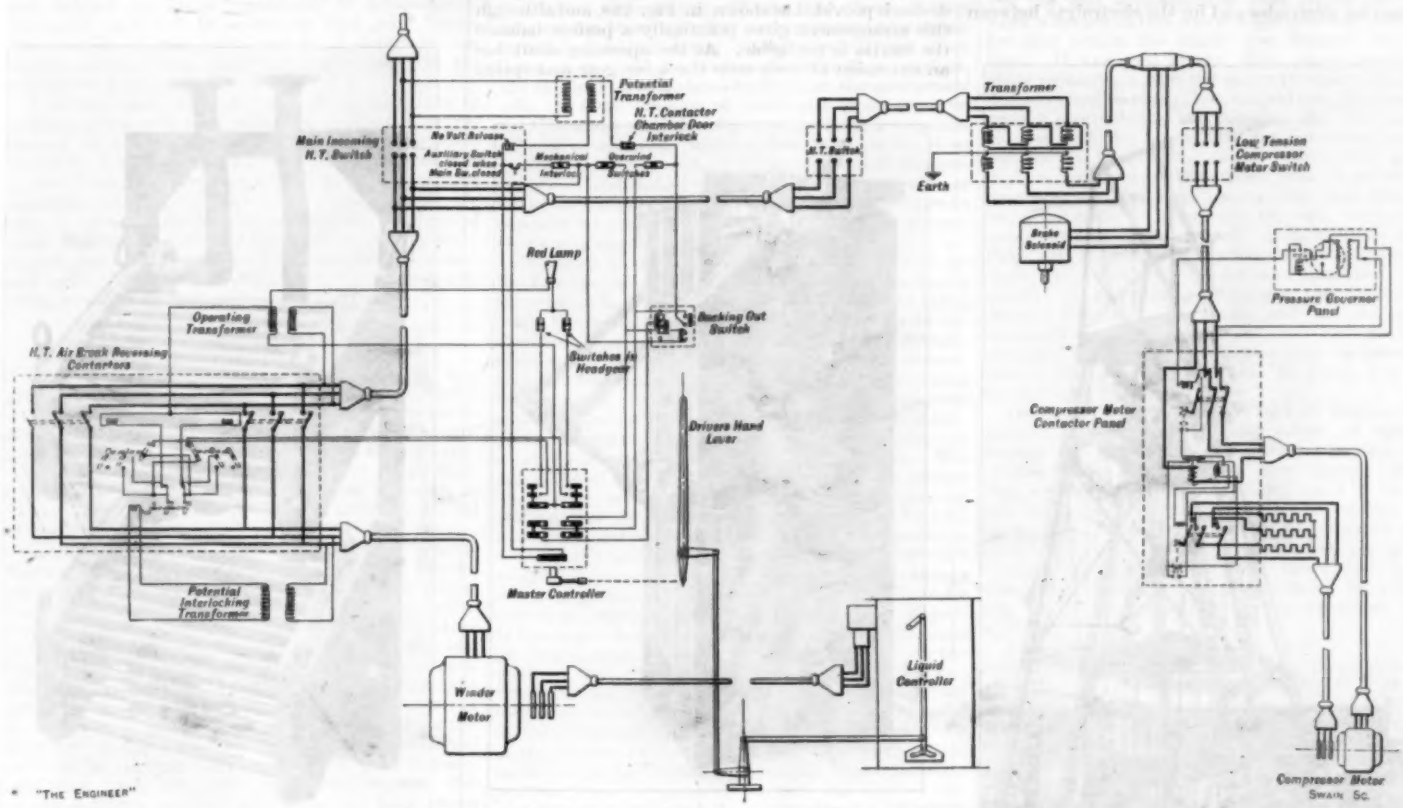
open the switch in the event of an overload or of a failure of the supply. An auxiliary triple-pole oil switch supplies current to a step-down transformer, to be seen in the top right-hand part of the diagram, and this transformer provides a three-phase supply for operating the three-phase brake solenoid, and the 10 horse-power motor for driving the air compressor which supplies the air for operating the mechanical brakes. It will be gathered from the diagram of connections that the compressor motor is started automatically by contactor gear, which is controlled by an air pressure governor. As the pressure rises and falls, according to the demand for air, the governor causes the contactor gear to stop and start the motor. Incidentally, it may be mentioned here that in connection with the braking system a dashpot is provided, which, in the event of the driver finding it necessary to apply the brakes during a wind, causes the brake shoes to be applied gradually, though at the end of the wind this dashpot is automatically put out of action.

The driver's hand lever, to be seen in the centre of the diagram, is, of course, operated from the driver's platform. It operates a master controller, which actuates magnetically-worked high-tension air break switches of the contactor type, which control the stator current, so as to make the motor run in either direction. Views of these contactor switches, which are provided with magnetic blow-outs, are given in Figs. 265 and 266. The lever also controls interlocking contacts—incorporated in a small master controller—for completing the various safety and interlocking circuits, and a liquid controller in the rotor circuit of the main motor.

It will be seen that two potential transformers are used in conjunction with the stator reversing contactors. One provides the operating current, and the other current for an interlocking system, so that when one set of contactors is opened the second set cannot be closed until the arcs at the first set of contactors are completely broken. In the absence of this electrical interlocking system it is evident that a short circuit might be produced owing to a sustained arc, but as the interlocking transformer is connected across the motor circuit that cannot occur. Mechanical interlocks also prevent the two sets of contactors for forward and reverse running being closed together.

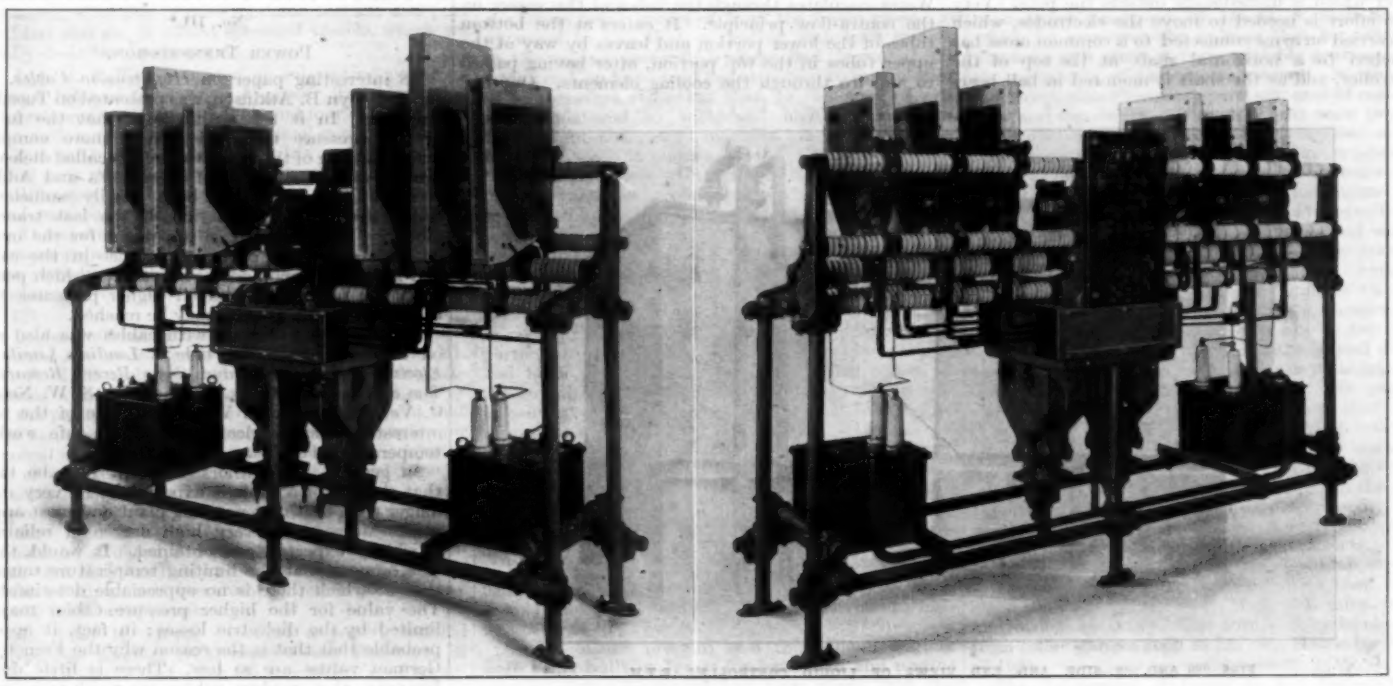
A very complete and effective emergency and indicating system is provided. On the driver's instrument-panel red and green indicating lamps are mounted. The green lamp indicates when the 3300-volt supply is available, whilst the red lamp lights up in the event of the driver starting the winder in the incorrect position. A limit switch fitted on the head gear, which is shown in Fig. 267, completes the red lamp circuit, and if the driver should ignore this signal or for some other reason should fail to stop and reverse the motor, another limit switch comes into action and interrupts the main supply and applies the brakes. Special arrangements are also fitted to enable the driver to back out after an overwind, and it is impossible for him to move the overwound cage further into the headgear.

The liquid controller used for varying the speed by inserting resistance in the rotor circuit is built on lines quite different from those of the usual type of controller with vertical electrodes. The advantages claimed for it are: (1) Positive operation from the driver's hand lever; (2) ease of manipulation at all speeds; (3) the variation of resistance is proportional to the movement of the driver's lever; (4) a large ratio is obtained between the maximum and minimum resistances, corresponding to the "full out" and "full in" position of the moving electrodes; and (5) unrestricted circulation of the electrolyte. This controller, which supporting three pots and three fixed electrodes, is illustrated in Figs. 268 and 269, consists of a steel tank containing a steel frame, as shown in Fig. 270,



"THE ENGINEER"

FIG. 264—DIAGRAM OF CONNECTIONS OF COLLIERY WINDING PLANT—B.T.H.



FIGS. 265 AND 266—FRONT AND REAR VIEWS OF AIR-BREAK HIGH-TENSION REVERSING CONTACTORS—B.T.H.

and it also contains a cooler as shown in Fig. 271. Each of the fixed electrodes is carried at the end of an insulated rod inside the pots, the other end of each rod being connected to one of the main terminals in the dividing box. All the pots and rods are composed of steel and are covered with an insulating compound which is unaffected by the electrolyte and which has very high insulating properties. Between the side walls of each pot there are baffles, which are broken in the middle so as to leave a space for the passage of the moving electrodes and for the electrolyte between

FIG. 267—COLLIERY HEAD GEAR

the moving and the fixed electrode which is situated at the closed end of the casing.

The baffles prevent the main current from straying from the direct path between the electrodes, and they also guide the heated electrolyte, which circulates upwards through the pots and downwards through the cooler which is immediately outside the pots. Very little effort is needed to move the electrodes, which are carried on arms connected to a common cross bar attached to a horizontal shaft at the top of the controller, and as the shaft is mounted in ball bearings the whole system can swing freely like a pendulum, to or from the stationary electrodes. Each time the motor is started the electrodes move from the "full out" to the "full in" position irrespective of the direction in which the driver's hand lever is moved, and the direction in which the main motor is made to rotate. This result is brought about by arranging matters so that the roller at the end of the vertical operating rod to be seen in Fig. 269 occupies a central position in the cam plate as shown in Fig. 264, when the electrodes are in the "full out" position and movement in either direction depresses the roller and brings the electrodes to the "full in" position. Moreover, the slot in the cam plate is so shaped that the movement of the electrodes makes the resistance in the rotor circuit practically proportional to the movement of the lever. Because of the large ratio between the maximum and minimum resistance the controller is admirably suited for reverse current braking.

In order to balance the moving system a spring device is provided as shown in Fig. 268, and although this arrangement gives practically a perfect balance the inertia is negligible. As the operating shaft has an extension at both ends the lever gear and spring

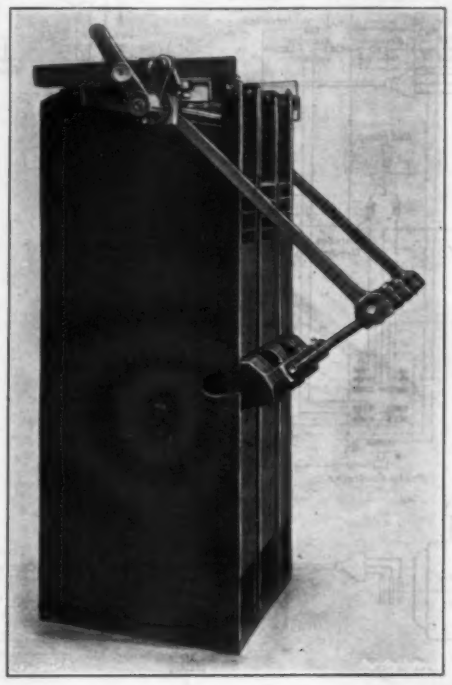


FIG. 270—CONTROLLER POT-UNIT—B.T.H.

balancing arrangement can be mounted on either side. Moreover, since the electrode pots, stationary electrodes, and moving system are attached to a top supporting frame, they can be withdrawn from the tank as a single unit, the moving electrodes being first moved to the innermost position and held there by a small locking piece on the spring arm shown in Fig. 268. The cooler can also be lifted out of the tank complete after removing the pipe connections. Water circulates through the tubes of this cooler on the contra-flow principle. It enters at the bottom tubes of the lower portion and leaves by way of the upper tubes in the top portion, after having passed to and fro through the cooling elements. One end of the cooler is fixed rigidly, whilst the other is supported so that the cooler is free to expand.

As shown in Fig. 268, the rotor cables are brought into a terminal box which will take one or two bifurcating boxes according to requirements, or alternatively by means of separate cover plates the cables may be led in through pipe conduit or through plain bushes. On test the controller was found to be capable of dissipating 400 kilowatts continuously, the ratio of the maximum to the minimum resistance was of the order of 400 to 1, the force required at the driver's handle to operate the controller and master control switch was about 10 lb., and the full range of the controller was covered in about five seconds. During the test a current of 1000 ampères was easily carried. When the controller had been filled with electrolyte, which consists of a solution of washing soda, a pressure of some 3000 volts was applied to the terminals of the controller, and it was evident that considerably higher pressures could be used if necessary. That the insulating compound was well able

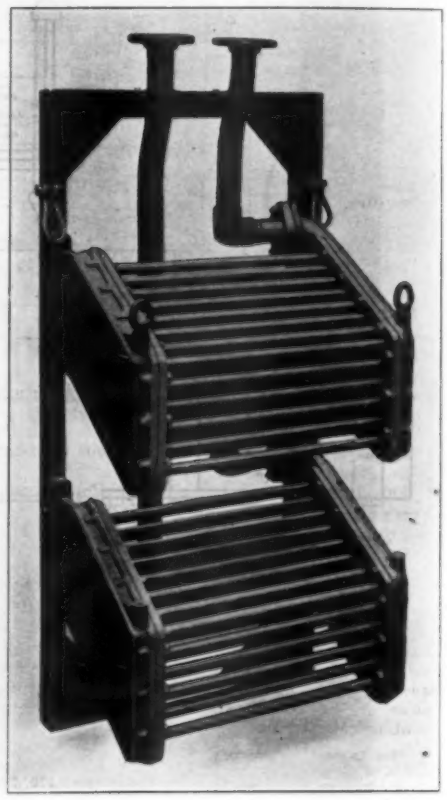
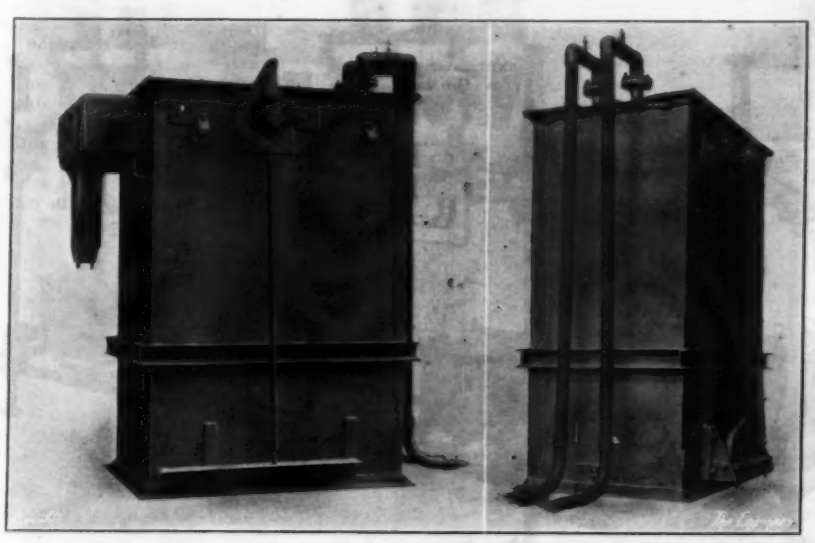


FIG. 271—COOLER FOR LIQUID CONTROLLER—B.T.H.

to stand up to its work was shown by the fact that a pressure of no less than 32,000 volts was needed to break it down.



FIGS. 268 AND 269—SIDE AND END VIEWS OF LIQUID CONTROLLER—B.T.H.

The World Power Conference.

No. III.*

POWER TRANSMISSION.

AN interesting paper on *High-tension Cables*, by Mr. Llewelyn B. Atkinson, was presented on Tuesday, July 8th. In it the author says that the future of high-pressure cables lies in a more complete understanding of the real nature of so-called dielectric breakdown. The lesson of Evershed's and Addenbrooke's researches has been hardly sufficiently assimilated. The elimination of the last trace of moisture which proved so important for the incandescent lamp is of equal importance in the cable, and given that methods or substances which permit of it are forthcoming, much higher pressures than those which seem feasible may be reached.

Another paper dealing with cables was also read on the same day. The title is *Loading Limits for Electric Power Cables and Some Recent Researches*. The authors are Messrs. E. Fawssett, S. W. Nelson, C. Vernier and E. B. Wellmore. One of the most interesting matters dealt with is the safe working temperature of cables.

In general, the authors state, it may be taken that the life of a cable is expected to be very much longer than that of generating plant and most apparatus. Moreover, a very high degree of reliability is rightly expected and obtained. It would, therefore, appear that the limiting temperature must be that at which there is no appreciable deterioration. The value for the higher pressure cables may be limited by the dielectric losses; in fact, it appears probable that that is the reason why the French and German values are so low. There is little doubt, however, that modern cables are much more satisfactory in that respect. For the lower pressure cables, however, the limiting factors due to the high temperature, are deterioration of the properties of the dielectric, and mechanical stresses set up by differential expansion of the conductors and sheath under intermittent loads. (This, of course, is apart from the purely commercial consideration expressed by Kelvin's Law which takes into account the cost of the cable itself.)

A large number of tests are in progress with various

* No. II. appeared July 11th, 1924.

makes of cable; small sealed samples of actual cable being exposed to heated air and tested for mechanical properties at stated intervals. Four different temperatures are being taken, and it is hoped that these tests will provide an indication of the temperature at which final full scale tests should be made. For these latter, lengths of at least 15ft. of extra high-pressure three-core cable will be maintained continuously, and for a long period at a given temperature and subject to cyclic variations of temperature. The cable ends will be sealed up with joint boxes. The samples of each cable will be in duplicate, one length of each being subjected continuously to the normal working pressure.

A further and important section of work now in contemplation will deal with the conditions appertaining to the use of cables in railway work. Here the cables are generally supported on racks at the side of the track, and are subject to wide temperature variation owing partly to direct heating from the sun, to continuous vibration, and to mechanical stress due to the supports being placed at intervals. In fact, the conditions appear to be especially severe, and quite different in nature from those obtaining when a cable is buried in the ground.

INTERNAL COMBUSTION ENGINES.

Internal combustion engines were handled in a group of nine papers, which were presented in Hall 2 on Tuesday morning, July 8th. *Internal Combustion Engines* is the title of a paper by Mr. James Richardson. Referring to large gas engines, the author says: "It is understood that the largest double-acting four-cycle gas engine building now has four cylinders of 51½in. diameter by 59in. stroke, and develops a total of 8000 brake horse-power at a speed of 94 revolutions per minute. This engine has overhung cranks. Recent improvements in simplification of design attaining symmetry of parts subject to heat stress, the selection of better materials, improved valve gear, and the use of exhaust gas boilers make these units attractive propositions." Discussing the development of the marine oil engine, Mr. Richardson shows that in them also, by attention to the points just mentioned, cylinders developing 2000 horse-power apiece become practical possibilities. He does not see any hope of the immediate realisation of the internal combustion turbine, and remarks, in that connection, that "any decrease in maintenance costs, due to the rotating motion, supposing the heat stress questions are eliminated, will be more than counterbalanced by the increased fuel consumption."

A long paper on *Gaseous Explosions Within Closed Vessels* was contributed by Professor R. V. Wheeler. In it the author advances the view that "the development of pressure within a closed vessel, due to the combustion of a gaseous mixture, is, in general, coincident with the spread of flame therein; so that, except in special circumstances, the moment of attainment of maximum pressure corresponds with the moment of complete inflammation of the mixture." This opinion is reached as the result of experiments on different mixtures of pure methane and air, and pure ethane and air, in closed spherical vessels, which are fully described in the paper.

Ing. G. F. Tosi provided an interesting paper on *Large Internal Combustion Engines*. Touching upon the relative merits of two-cycle and four-cycle engines, the author remarks that the Diesel engine is similar to a steam boiler in that, if long life is desired, superficial area must be taken into account in connection with steam raising, and only certain quantities of fuel can be satisfactorily burnt per square metre. In Diesel engine practice it is not prudent to surpass certain values for fuel burnt, and since these values are already attained in the four-cycle engine, it is useless to force the engine by adopting the two-cycle.

Under the heading *Development of the Internal Combustion Engine in Sweden*, Professor Hubendick, Mr. K. J. E. Hesselman, and Mr. Gunnar Dellner presented a series of short notes. In a general survey of the position, Professor Hubendick pointed out that the main value of the internal combustion engine for central electric stations was to meet peak loads or to be of service in case of trouble. A special type of quick-starting Diesel engine, known as the "reserve type," has been developed for this purpose. The authors hold that it is desirable that reserve stations should be situated as near as possible to the main load that they are likely to be called upon to supply. Most of them are therefore of small powers—say about 2000 horse-power.

Mr. Paul R. Meyer provided a paper, entitled *Large Gas Engines in German Power Economy*, in which he states that since the introduction of supercharging a four-cylinder gas engine developing as much as 12,000 horse-power has been built. Much of the heat hitherto lost in the cooling water is now recovered in the form of steam at low pressure; as much as .36 horse-power for every 1 horse-power given by the gas engine is developed in suitable steam turbines, bringing up the total thermal efficiency to 36 per cent. Wherever there is gas to be disposed of, as in steel works, 50 per cent. more power can be produced in a gas engine power station than in one employing the best steam turbines. The last paper in this section to which we shall allude is one written by Professor Charles Edward Lucke, of Columbia University, which is entitled *The Internal Combustion Engine*, and is an interesting review of the position now occupied by gas, oil and spirit engines.

Mr. James Richardson, after a brief presentation of his paper, said that the Diesel-driven Atlantic liner of over 50,000 horse-power on four shafts had become with double-acting engines a probable and profitable undertaking. There had been during the past ten years a gradual improvement in materials capable of withstanding higher temperatures than those now used in internal-combustion engines, and the field had also been explored on the mechanical side. A large amount of work was in progress on the Continent with the object of evolving a practical internal-combustion turbine, but he regarded it as doubtful whether, without great advances in thermodynamics and metallurgy, such a machine could, as far as economy of operation was concerned, hope to compete for many years to come with the reciprocating type of engine.

Professor E. Hubendick (Sweden) commented on the fact that there was no aeroplane engine industry at present in Sweden. A special effort was being made to use alcohol derived as a by-product in the chemical wood pulp industry as fuel for internal-combustion engines. Attention was being concentrated in Sweden on the hot bulb engine, the aim being to construct an engine which, while comparable with the hot bulb design from the standpoint of simplicity, would as far as operating costs were concerned, rival the results obtained with Diesel engines. The Atlas Diesel interests had lately put on the market an engine which possessed those characteristics, and another firm, the A/B Svenska Maskin-Verken, had produced a similar design. Both machines were of the solid injection type, but they worked with high pressures, and it would be an advantage if lower pressures could be utilised. The Bolinder firm was making investigations with that object. It was hoped to introduce the solid injection principle for larger engines, and an account of some of the work in that direction had been published in THE ENGINEER on September 22nd, 1922. Experiments were now being made in the utilisation of the solid injection method for the combustion of heavy oils in the engines of motor lorries, but nothing definite could yet be said in that connection. The immediate problem ahead of research workers was that of discovering a new principle by the application of which the transformation of heat into mechanical work could be carried out at higher efficiency than was now possible; but whether that engine would be of the internal-combustion type or of another kind he would not venture to predict.

Professor Grigg (Canada) referred to an engine, the Hvid engine, which was used in Western Canada, the characteristics of which were high compression in association with high efficiency.

Mr. Pochobradsky said a method of injection which was now being experimented with was the use of high-pressure steam in place of high-pressure air, the steam being produced from the waste gases. It appeared to him that in dealing with heat stresses in the engine; research workers had begun at the wrong end, and had paid less attention to the question of temperature reduction than to the need of providing material to withstand high temperatures. He thought the geared machine had a considerable future before it in marine service.

Mr. Hutchinson (United States) expressed the opinion that the strong position held by the large steam public utility companies in America had retarded the development of the internal-combustion engine, except for special purposes, such as in steel works where blast-furnace gas was available.

Mr. Gibbons criticised those associated with the internal-combustion industry for lack of progress in raising the thermal efficiency of that prime mover, particularly the gas engine. The oil engine perhaps had made a little more advance. With regard to the large internal-combustion engine its development as compared with the steam turbine had been handicapped by high costs.

Mr. Arthur H. Lymn referred to the work in progress in Germany in the evolution of the internal-combustion gas turbine. A 5000-kilowatt gas turbine set of the Holzwarth design was now in operation and it was clear that something practical was being done. He understood that the inventors were willing to build a turbine of that design with the guarantees usually given in connection with steam turbines. It was stated that the efficiency of that gas turbine was from 21 to 22 per cent.

Dr. M. Kamo (Japan) said that Diesel engines were being built in Japan for both land and marine service, and a beginning had been made with the building of aero engines. For submarine work a number of Diesel engines were being constructed by private firms and in the naval workshops, and it was anticipated that the output capacity would be sufficient to supply the submarines of the Japanese Navy with their machinery equipment.

Dr. Nagel (Germany), in reply to a question, said that the efficiency of the Vulkan gear was about 70 per cent. in going astern and 97 per cent. when going ahead. The efficiency of the hydraulic Lentz gear was from 82 to 83 per cent.

Mr. J. L. Chaloner dealt with the use of high-pressure steam for injection purposes, and expressed the opinion that that was only a transition stage, and that efforts must be concentrated on the retention of the essential quality of flexibility with a fairly wide range of fuels.

Mr. H. A. D. Acland believed that with heat recovery by means of steam and the utilisation of that steam in the same engine, as was done in the Still design, much higher efficiencies could be obtained. For the first application of that engine for marine work a saving in fuel was not the primary object, and for that reason the engine was designed on simple lines. It was well known that supercharging and other refinements were necessary to obtain the highest degree of fuel economy, but it could only be done at the cost of complicating the design. Mr. Still had had to deal with the question of temperatures, but that was not the limiting factor; it was rather a question of temperature difference than of actual temperature. It had been shown that that need only be of the order of magnitude between the inner and outer surfaces of the cylinder walls of 40 to 50 deg. Fah., and that such differences in heat stresses were negligible. The Still design was simplified by the ability to compromise between the theoretically desired compression pressure and the compression necessary to ignite the fuel. He was somewhat surprised to learn that in German practice gas engines were giving only about 1 kilo. of steam per brake horse-power hour.

Dr. P. R. Meyer (Germany) said, in making a comparison of the steam raising power of large gas engines and of the Still engine, there had been a misunderstanding. In German gas engine practice they obtained from the exhaust gases 2 lb. of steam per brake horse-power and from the cooling jacket about 1 lb., which equalled the performance of the Still engine. He would point out that an internal-combustion engine from which more than 3 lb. of steam per brake horse-power could be obtained was giving an unsatisfactory performance as an engine.

Professor Hubendick noted that in connection with the internal-combustion turbine of the Holzwarth type, the efficiencies obtained were very little more than 14 per cent. His own opinion was that while the internal-combustion turbine might prove useful it would never be an engine of high efficiency.

Mr. R. E. Mathot (Belgium) said that on the Continent experiments were being carried out on lorries equipped with internal-combustion engines using suction gas produced from charcoal, which could be obtained for one-third the price of petrol. Its disadvantage was that when it was used in an ordinary engine there was a loss of power of about 20 per cent.

ROAD AND AIR TRANSPORT.

On the afternoon of Tuesday, July 8th, Sir Charles Morgan (president of the Institution of Civil Engineers) presided at a section which discussed a group of papers dealing with road and air transport.

Variable Transmission Gears formed the subject of a paper presented by Dr. H. S. Hele Shaw, in which he expresses the opinion that for most purposes we still await a truly variable gear combining the properties of cheapness, moderate weight, high efficiency, smoothness of operation, ease of manipulation and durability. If such a gear were produced it would be applied to many new purposes, and the employment of internal combustion engines and electric motors would be greatly increased. He points out that variable transmission means either variable force transmission or variable speed transmission, according to the object in view, and classifies transmission gears under the headings frictional, mechanical, electric, pneumatic, and hydraulic. Frictional gears, he says, give infinite variation, but are in general applied only in connection with small powers. Mechanical gears are of two kinds, continuous and intermittent. In the second division are the de Lavaud ratchet and swash plate gears and the Constantinesco torque converter. He questions the desirability of providing a speed gear which changes automatically with the varying resistance, so far, at any rate, as a motor vehicle is concerned, for in such a case, next to the steering, the driver's chief concern is to have personal control of the speed. Electrical variable gear is briefly dismissed. Pneumatic variable transmission, he holds, cannot be said to have proved a practical success. Under hydraulic variable transmission he bestows chief attention on the system devised more than twenty eight years ago by Mr. J. W. Hall, of London, leaving his readers to study other forms of hydraulic gear from other sources such as his own Hawksley lecture of 1921.

The Application of Power to Air Transport was dealt with in a paper by Mr. Alec Ogilvie, who expresses the opinion that engine development has now gone beyond aeroplane development, and that aeroplane design is at present not making full use of the engines available. In the development of the aero-engine, he says, there has been a constant struggle between trustworthiness and light weight. At the end of the war we were using engines of 350 horse-power which, with their air screws and all accessories, weighed about 3½ lb. per horse-power. To-day civilian machines have engines of 450 horse-power weighing 2¾ lb. per horse-power,

and in the Air Force engines of about 1000 horse-power are in use, which weigh 2½ lb. per horse-power. With sufficient expenditure of money engines of 1½ lb. per horse-power could be produced. In a modern civilian machine, 60 horse-power has to be provided for every passenger carried, as compared with ¼ horse-power in an omnibus, 1 horse-power in a train, and 5 horse-power in a short distance high-speed steamer. Air transport is, thus, heavily handicapped. Its high speed of 100 miles an hour is absorbed in competition with the weather rather than with the 15, 25 or 50 miles an hour of the omnibus steamer or train. The crude oil aero-engine, on the development of which work is now going on, would permit the use of a cheaper and safer fuel, but if it added only 1 lb. more per horse-power to the weight of the power unit it would necessitate the discarding of two passengers out of seven, whereas the difference in fuel cost would be equivalent only to one passenger's fare. He holds, nevertheless, that the crude oil engine has a future before it for use in very large seaplanes and airships.

In a paper entitled *Power Applied to Road Transport*, Colonel R. E. Crompton summarises the history, present position and outlook of the steam and the internal-combustion engined road vehicle and of electric vehicles of the trolley and storage battery types. Speaking about the first pair of these four classes he says that among the possibilities of the future are the development of the coke-fired steam vehicle of the Clarkson type, the use of pulverised fuel, the adoption of heavy oil engines, and the application of steam turbines in conjunction with an electrical method of gearing down. On the electrical side he holds that, given a wide distribution of power in the rural districts, the tramway system of driving vehicles is likely to be considerably extended because of the economies resulting from the reduced cost of labour, upkeep charges and expenditure on tires. The accumulator vehicle is being widely adopted in this country for, in spite of its comparatively high first cost, it has many outstanding advantages, notably in the high ratio which the useful load carried bears to the total moving load. He foresees a huge future for the accumulator vehicle. Even already, he says, there is every reason to believe that the cost of moving heavy loads at 10 miles an hour by electric vehicles is on a level with that of moving the same load by internal-combustion engines.

In the discussion on this group of papers, Colonel R. E. Crompton, commenting on the statement by Dr. Hele-Shaw that friction gears could only be used for small powers, said he had knowledge of a 25 horse-power tractor in which a friction gear had worked quite successfully. The review of the gearing problem made no reference to the Ward Leonard gear, which for use with rolling mills and other heavy power requirements worked well and with good efficiency. As one who had been closely associated with the steam vehicle, he repudiated the suggestion that the steam system had failed. Speaking as engineer to the Road Board, he desired to emphasise the need for a closer alliance between the vehicle designer and the road engineer, so that the vehicle should do less damage to the road and the road should be constructed to meet the trend of vehicle design.

Mr. E. J. Wheldon expressed the opinion that the designer of mechanically-propelled road vehicles had been misled by the small bulk of the internal-combustion engine, and had followed the wrong lines. The sound line of progress was to produce a commercial motor which would haul vastly greater loads than it could carry under present conditions without exercising a crushing effect on the road surface. Vehicles of that type must come soon, if economy with transportation by road was to be obtained. Railway practice had demonstrated that far greater loads could be hauled than could be carried.

Major Mayo raised the question of the useful load in the case of aeroplanes. The machine operating on continental routes had, he said, a total load capacity of 16 lb. per horse-power, but a paying load of only from 3 lb. to 4 lb. per horse-power. Those figures indicated the importance of not incorporating features in design which would increase the weight of the machine in relation to horse-power. That point was even more important than reliability. The aero-engine now had a fair degree of reliability, but if that quality could only be improved at the cost of weight addition the price could not be paid, at all events, not in commercial machines. The use of gearing would mean an additional weight of 1 lb. per horse-power. There was now a very wide range of horse-power for aircraft engines. At the present time an engine of 1000 horse-power was actually being used and was by no means too large. There was indeed every indication that engines of 2500 horse-power and 3000 horse-power would be required for the larger sizes of aeroplanes and seaplanes within the next ten years. At the other end of the scale were the one-man machines which could be fitted with motor cycle engines and which gave useful service.

Power in Agriculture.

On Wednesday, July 9th, Mr. R. Borlase Matthews read a paper on *Electro-farming Economics*. It has often been stated that a farm load is of little value to central station engineers, on account of the poor load factor, but Mr. Matthews shows that that idea is erroneous. A poultry farm is shown to have a load factor of 55 per cent., an arable farm 31 per cent., a mixed farm 15 per cent., and a dairy farm 13 per cent.; whereas the load factors of a wood-working factory, and engineering works and a printing works, are 5, 6, and 8 per cent. respectively. The largest electric hatchery of which the author has particulars specialises in the day-old chick trade, and runs only five months in the year. It has a capacity of 120,000 chicks per week, or, say, 150,000 eggs, and consumes 50,000 to 80,000 units per week, with a maximum demand of 400 kilowatts, during the operating period. In dealing with distribution, the author states that in England three-phase overhead lines cost about £500 to £550 per mile; whilst cables would cost about double that amount, including laying. On private land in this country the author has put up lines for £200 per mile; whilst in Sweden similar work has been done for £100 per mile. The use of galvanised steel wire, the paper states, should be avoided, as it only adds to the distribution difficulties. The advantages of single-phase distribution are discussed, and it is considered that under favourable conditions it might be possible to lay cables of this type at a cost of £350 per mile. The cost of laying cables, the author points out, can be minimised by the use of trench diggers and caterpillar tractors for hauling deep-cutting ploughs. A very serious matter for consideration is the cost of connection to extra high-tension lines. In accordance with British practice, the cost is almost prohibitive. It is, of course, appreciated, the author states, that continuity of service is most important, but there must be a happy mean between the best British practice and the cheapest continental customs. The author also refers to the seriousness of the high wayleave charges in this country, and points out that a wayleave charge of 1s. per pole per annum represents a rental of nearly £1000 per acre.

Power for Rail Transport.

Mr. Roger Smith, who presided on Wednesday afternoon at the first session of the section which discussed a group of papers dealing with railway transport, gave short summaries of the papers.

A paper by Professor Franco, *Some Considerations on the Development of Railway and Tramway Traction*, gives an historical review of the development of the steam locomotive up to the Stephenson locomotive used in 1825 on the Stockton and Darlington Railway. The author shows that the best thermal efficiency as between heat in the boiler furnace and draw-bar pull in the modern steam locomotive is 6.2 per cent. He goes on to refer to steam turbine locomotives, steam turbo-electric, Diesel-electric, as now largely used in Sweden, and internal combustion engine locomotives generally. He refers to the Still engine using both oil and steam, and describes the oil engine auto-rail cars used in Holland.

A paper, *Testing Locomotives on the Great Western Railway*, by Mr. C. B. Collett, describes methods of testing the modern types of high-pressure superheated steam locomotives on the road and gives charts and diagrams of results of a test lasting over six days of a 4–6–0 locomotive of the "Castle" class running on the Great Western Railway on the 226 miles between London and Plymouth and back the next day—the longest non-stop run in the world. From these tests the thermal efficiency between work done in the cylinders and the heat in the coal is 8.22 per cent., and multiplying by the mechanical efficiency of the engine determined on these tests, namely, 74 per cent., the thermal efficiency at the draw-bar is 6.1 per cent., confirming Professor Franco's figure.

A contribution on *Power Saving Through Anti-friction Bearings*, by Mr. Forsberg, of Sweden, gives ten years' experience of the use of roller bearings on the Swedish State Railways on locomotives, express carriage rolling stock and wagons. Experience shows that the starting effort is reduced by 85 per cent., and that nine test runs on similar trains with and without friction bearings resulted in a saving of 11.5 per cent. in locomotive coal in favour of roller bearings, or that for the same draw-bar pull the weight of the train could be increased by 30 per cent.

A paper on *The Internal Combustion Engine for Transportation*, by Mr. Lucke (U.S.A.), states generally that all internal combustion engines for transport are of the gasoline (petrol) type, except for marine propulsion, where large oil engines are used, as also for rail transport. The paper contains a detailed quantitative analysis of the use in the United States of gasoline engines in motor cycles, road motor vehicles—both passenger and commercial—and an analysis for each group of types of engines, clutches, brakes and tires. For rail vehicles, analysed in the same way, the author says that the oil engine locomotive has not passed the experimental stage, although oil engine auto-vehicles up to 250 horse-power are used on 157 railroads in America.

Continuing, Mr. Roger Smith said that there were six papers on railway or tramway electric traction from countries dependent on imported coal, with water powers developed or capable of being developed. Those countries were Austria, the Dutch East Indies (Java), Italy, Norway and Sweden.

A contribution on *The Electrification of the Austrian Federal Railways*, by Dr. Arthur Hrushka, shows that Austria has now only twenty years' supply of coal, and, as a result, is developing her water power resources and electrifying her railways as fast as she can. The reasons given in the paper for electrifying the Austrian Federal Railways are:—(*a*) The prevention of the importation of coal; (*b*) the economy in service on lines of dense traffic and heavy gradients; (*c*) the traffic advantage of increased speed on gradients; (*d*) the employment of home industries in supplying equipment and power. Six hundred and fifty-two kilometres (405 miles) are going to be electrified at once, and the whole immediate programme of railway electrification amounts to 1838 kiloms. (1150 miles) of line with more in the future. Single-phase working at 15,000 volts, 16⅔ frequency, has been standardised, and work in the first electrified section started a year ago.

Dr. De Gelder, in discussing *Electrification of Railways in the Dutch East Indies*, pleads for the combination of a general supply of electricity from the available water power resources of Java for industrial and domestic uses, as well as for railway traction. Various reports on Javan railway electrification are discussed, and it is noted that the electrification of the lines round Batavia was started in 1920. Direct-current traction at 1500 volts has been standardised.

A paper, entitled *Electric Traction in Italy*, by Professor Tajani, gives a history of the development of electric traction since the Valtellina line was equipped on the three-phase system in 1901. The author argues that any of the available systems of electric traction can be used. The important thing is to choose one and to stick to it. The Italian State Railways now have 650 kiloms. (400 miles) working on the three-phase system, with 3700 volts between phases and at a frequency of 16⅔, and the author points out that such a system is of use only for traction, and is of no use for industrial supply.

In a review of *Electrification of Railways in Norway*, Mr. Schreiner points out that in his country, which is the size of the British Isles, there are only 3,000,000 inhabitants, and as a consequence only 2600 miles of railway line owned by the State. The country hopes to replace the use of imported coal by developing the splendid water power resources of Norway. The paper very clearly describes schemes for reducing the capital cost of installation in every possible direction, largely by deliberately taking any risks there may be in avoiding the duplication of plant. The system of traction standardised is single-phase 15,000 volts at about 15 frequency, and it has been decided to use separate generating sets and transmission for this traction supply. A full description of the troubles to be met on telegraph and telephone lines and the methods proposed for getting over them is included.

In *Power Problems on the Swedish Railways* Mr. Ofverholm describes the northern line, 503 kiloms. (311 miles) long, including a portion in Norway, for bringing iron ore down to the Baltic. It is the longest electrified line in Europe. Another line from Stockholm to Goteborg, now being equipped, will be 458 kiloms. (284 miles) long. Both are equipped on the single-phase system at a frequency of 15 or 16⅔, using the general national three-phase hydro-electric supply so highly developed in Sweden, single-phase railway supply being given from motor generators. Privately owned lines, totalling 270 kiloms. (170 miles) are electrified, and one of them 150 kiloms. long, worked single-phase at 16,000 volts, 25 frequency, has only one feeding point in the middle. The telegraphs and telephone lines, which are removed to a minimum of 200 m. from the railway, suffer no disturbance. Installation costs and power consumption for the State Railways are given.

In a paper on *Power Questions relating to Swedish Tramways*, Mr. Hultquist gives an historical and economic review of the development of hydro-electric power in Sweden, first for the tramway-owned power stations, and later for the general supply of electricity for industrial, domestic and traction uses. Full tables and curves of tramway statistics are given. The traction supply is direct current at 600 or 1200 volts.

Other papers deal with countries which possess coal, and in which main-line electric traction is adopted only if it is economical to do so from the railway, as opposed to the national, point of view. These countries are Germany, Great Britain and the United States of America.

In describing *Main-line Electrification on the State Railways of Germany*, Mr. Wilhelm Wechmann points out that there are 600 kiloms. (370 miles) of State-owned railway worked on the single-phase system at 15,000-volt 16⅔ frequency. Rejecting direct current for traction, on account of converting machinery, and admitting the advantages of three-phase traction taken from the public supply, the State Railways have adopted the single-phase system, with single-phase generation and transmission wholly for railway purposes. The author considers that railway traction power stations should be owned by the railways, and used primarily for railway electric supply. Besides the standardisation of single phase at 16⅔ frequency, 15,000 volts, transmission at 110,000 volts carried 50 m. to 100 m. away from the railway is standardised. Six types of electric locomotive have been standardised—fast, slow passenger, and goods—one of each type being designed for hilly and one for

flat country. Locomotive parts are also standardised. Tables with full particulars of two types of locomotive are given, and while it is pointed out that with single-phase transmission the number of electric motors on a locomotive is not restricted, the author urges the simplicity of one motor. Very interesting charts of the motor temperature rise during a trip are given, as well as charts of dynamometer car tests and diagrams of energy distribution in the locomotive. The advantage of raising the average speed of goods locomotives is brought out. Diagrams of comparative coal consumption on a hilly line in Silesia for steam and for electric working over three years are given, and telegraph and telephone troubles are dealt with. Tables of the comparative working costs for steam and for electric working on main lines are shown for (*a*) Central Germany, where the actual saving in working costs pays 6.6 per cent. on the capital cost of electrical equipment, including rolling stock and locomotives; (*b*) for Silesia, where the actual saving pays 10.6 per cent. on the capital cost of electrical equipment; (*c*) for Bavaria, where the estimated saving will pay 9.2 per cent. on the estimated cost of electrical equipment; and (*d*) for a railway in Silesia, where the estimated saving will pay 13.8 per cent. on the estimated capital cost of electrification.

The Financial Aspects of Main-line Electrification is treated in a paper by Sir Philip Dawson, which gives the fully and carefully worked out financial results for the complete electrification of the suburban lines of what was the London, Brighton and South Coast Railway, before its amalgamation in the Southern Railway and the extension to the main line to the south coast of that suburban electrification. The balance sheet of 1921, with steam working, is reconstructed on the estimated results of this electrification, amounting to 200 miles (320 kiloms.) of route on 500 miles (800 kiloms.) of single track. The increase in passenger traffic estimated by the traffic officers, and endorsed by the management and the administration, increases the annual revenue by £2,000,000. This estimated increase in passengers amounts to 125 per cent. for the suburban service and 60 per cent. for the main line, and when this increase is realised, the increase in net revenue will pay 17 per cent. on the entire capital spent on electrification. If the passenger increase were only 70 per cent. for the suburban services and 35 per cent. for the main-line services, the increase in revenue would pay 8 per cent. on the same capital as could provide for the larger increases in passengers first mentioned. The tables, very carefully prepared, cannot be further summarised, but the analysis illustrates the fact that when the traffic officers take the trouble really to go into the gains from electrification, the results on the dense services in Great Britain, even with a small goods service, are most encouraging. The system used is single-phase, 6700 volts, 25 frequency.

A paper on the application of power for rail transport, but the proper title of which should be *Electric Railways in Great Britain*, by Mr. Roger Smith, is statistical. The paper consists of tables containing technical data on a uniform basis for all the electrified railways in Great Britain, and is a record of what has been done in urban and suburban electrification with one piece of main-line mineral electrification on the London and North-Eastern Railway. On that line, 925 miles (1490 kiloms.) of single track and passenger sidings have been electrified, of which 857 miles (1380 kiloms.) are on urban and suburban lines, and only 48¼ miles (77 kiloms.) on main lines. Last year 486,000,000 kilowatt-hours were generated with a load factor of 35.7 per cent., and 330,200,000 kilowatt-hours were delivered from sub-stations for traction, resulting in 4,700,000,000 passenger ton-miles.

Mr. L. de Verebely said that in Hungary a new system had been evolved for main line electrification which made strict application of modern economic principles to traction requirements necessary in that country. For the production of power in Hungary reliance had now to be placed upon stocks of mineral fuels so limited in quantity that if waste was not severely checked they would not last longer than sixty years. The position was aggravated by the fact that the fuel resources were, to the extent of about 40 per cent., of low quality. It would be agreed that thermal power stations could only work at high fuel economy when equipped with large machines and run on a high load factor. The ordinary type of railway power plant did not meet that requirement, and advantageous load conditions could be obtained only by combining many consumers of quite diverse character into a common system. In the case of Hungary the standard system selected was three-phase alternating current of 50 cycles, and a very complete investigation embracing the main line railways of about 900 miles indicated that the power demand could be considered as a load of favourable character for a general station and might become a very desirable day and night base load where the capacity of the power supply was large enough. Two requirements, the smoothing down of excessive peak loads and the raising of the power factor to the highest possible figure, must be satisfied if the electric railway was to become a desirable customer of a general supply station.

The system based on these considerations chosen for Hungary was a development of that put forward in 1917 on the three-phase principle by Mr. de Kando, of Budapest. It was felt that that high tension three-phase system offered the best possibilities for obtaining the desired results with the least complications. In order to obtain a motor with good characteristics through a large range of different outputs as required in traction service it was necessary that the standard method of feeding the motors at constant pressure should be abandoned, and that the voltage applied should vary with the load according to a definite law. It could be shown that an induction motor would run throughout the whole range of its capacity with the highest possible constant efficiency if the pressure applied was varied proportionally to the square root of the input. The simplest way to fulfil that requirement was to place a motor generator on the locomotive driven by the current drawn from the trolley and to vary the field excitation of the generator side so that the pressure delivered to the main motors followed the law stated. It was then a simple matter to build the motor for 50 cycles single-phase current, leaving the generator to deliver three-phase current. In that way the good characteristics of the simple and robust three-phase locomotive could be combined with the simple, safe, and cheap trolley system used in single-phase equipment. A further important advantage could be obtained by making the single-phase motor of the synchronous type, in which case unity or any desired power factor could be automatically maintained constant in the primary circuit. Efficiency could be raised and the weight, price, and maintenance of the locomotive could be reduced if the motor and motor generator could be moulded into one. The solution of this problem was one of the features of the new system.

The pioneer locomotive was of the Decapod type, the two driving motors being mounted rigidly on the main locomotive frame. They were of the induction type with two independent windings. The phase converter placed above the motors had also two independent windings on the stator. Test runs had given satisfaction, a very important result being the demonstration that the working of a small three-phase power station was not disturbed by the single-phase railway loads. The main motors worked between wide ranges of load at the highest possible efficiency.

It could at least be claimed that the new system deserved serious consideration, as enabling the railway load to be fitted into the general power production scheme of any country and offering the simplest, safest, and most economic solution of one of the most urgent problems of the time.

Mr. W. J. Murray (United States), in a general account of developments in the United States, said that very heavy trains were being hauled by electric traction and consideration was now being given to weights of 6000 tons. As far as the economic distribution of power was concerned, he could say that 3000 volts was sufficiently high to deliver to the locomotive at a reasonable economic loss. There was experience of various systems of electrification, but he had reached the conclusion that the driving force on the train was going to be given by the direct-current motor, and the power supply on the high-voltage alternating-current system. Locomotive designers had gone far to meet those requirements, and to-day the motor generator locomotive was a better type than the split-phase induction engine, which was going to disappear from railway practice in the United States. The financial problem was more difficult than the technical, and it would be a great advantage if a system of a really practical character could be evolved by which current could be drawn from a general source and the financing of power supply be taken out of the hands of the railway companies and dealt with by other people.

Dr. H. S. Hele Shaw referred to the various attempts to develop the internal-combustion engine locomotive, a subject which he regarded as of the greatest interest for railway authorities in those parts of the world where, owing to the absence of water the steam locomotive could not be considered, and the electric locomotive was ruled out. There was, however, no indication at present of any development which would make the internal-combustion locomotive a practical machine for railway work. Discussing various forms of transmission, Dr. Hele-Shaw said he did not think pneumatic transmission could be dismissed as impossible, and he was in a position to predict new developments in hydraulic transmission.

Colonel O'Brien said that Mr. Murray had emphasised the importance of the financial problem in railway electrification, and had put in a plea for a greater degree of standardisation of the electric locomotive, so that it could be used to better advantage. In those suggestions he had gone a long way in summarising the railway problem in Great Britain. As far as suburban electrification was concerned, fairly full knowledge was now available. What was not realised by many people was the great advance which had been made during the past few years in the design of traction motors and traction equipment, and the development in power station work which had reduced the cost of current. The result was that rather misleading ideas had gained currency as to the real cost of suburban train working. The figures derived from installations now in service were too high. With regard to main-line electrification, it could not be carried out economically on a small scale. Sir Philip Dawson had fixed the cost of converting a considerable section of the Brighton main-line system at nearly £12,000,000. He submitted that that was an inflated estimate of capital expenditure, and included a number of items which should be charged against revenue. Taking the real capital outlay as being confined to equipment of the line and sub-stations, the real outlay to be debited to capital account would be nearer £3,000,000 than £12,000,000. The other items debited by Sir Philip Dawson against electrification were replacement charges. Railway traffic officers had not yet been made to realise the advantages of working main-line traffic electrically. The locomotive recently supplied by the General Electric Company of America to the Paris and Orleans Railway developed 3000 horse-power, weighed 120 tons, the maximum weight on any axle was 13 tons, and it could haul a 500-ton train at from 65 to 70 miles per hour. The latest type of standard steam locomotive would develop about 2800 horse-power, and had a weight of 240 tons, and would require two crews of enginemen, while the electric locomotive could do the same work with one crew. Two outstanding questions came up for consideration in connection with the electrification of British main-line railways. The first was one-man operation of locomotives, the second the cost of electrification of sidings, of which there was about one mile to every two or three of running track.

SIXTY YEARS AGO.

IN an article entitled "The End of Three Deckers," reprinted from *The Times* in our issue of July 15th, 1864, it was recorded that while the Admiralty had ceased to build wooden three-decker warships, it was still repairing, refitting and equipping its "wooden castles" as busily and believingly as it did before the days of iron. To continue to rely on such vessels for any purpose in war was, it was argued, as wise as the Indian's exposure of his naked body to conical bullets or the Chinaman's reliance on ramparts of calico and paper. It was suggested that the Admiralty's interest in wooden three-deckers was inspired partly by inertia to change with the times, and partly by the fact that vessels of this description provided roomy and comfortable accommodation for the ship's company. But when "an utterly contemptible foe, a Prussian gunboat perhaps," trusting to its lesser bulk but stronger skin had, with a few well directed long range shots sent one of our floating castles into the air or to the bottom, our Admirals would perhaps cease to prefer palaces of so precarious a type. . . . A sensational murder on the North London Railway and an incident on the South-Western, in which a woman, to escape the attentions of a fellow-passenger, clung to the outside of a carriage for five miles until the train reached a station, provided the subjects for a forcible leading article on the urgent necessity for some means whereby railway passengers might in emergency communicate with the driver or guard. We hesitate to describe our leading article as an encouragement to murder, but it certainly showed that in the absence of means of communication of the form with which we are now familiar, but which in those days was not in use on British railways, murders of the North London kind were easy to execute with impunity. "Special forms of crime," we find it written, "often rage as epidemics; it was so not long since with garotting, and we have reason to suppose that railway murders will yet become frequent." The problem of providing the necessary communication, it was argued, was not a difficult one to solve in spite of the complexity of most of the ideas on the subject submitted at the Patent Office. In America—where the use of communicating means was, because of the type of carriage used, much less necessary than in this country—no train would be started, we wrote, without its bell cord. A similar system might be tried in this country. The tracing of the signal to the carriage from which it had been given could be carried out in any of a dozen different ways, so as to lead to the abuse of the system being attended by punishment.

HIGH PRESSURE AND HIGH TEMPERATURE STEAM.

THE following particulars of recent turbo-generators on order and being built by the General Electric Company are given by Mr. Eskil Berg, of that company, in the June number of the *Journal* of the Franklin Institute:—

One 60,000-kilowatt cross-compound turbo-generating unit for Commonwealth Edison Company, Chicago. This unit is designed for 600 lb. pressure—700 deg. superheat and 29in. of vacuum. The unit consists of one high-pressure 17,000-kilowatt unit running at 1800 revolutions per minute, from which the steam is reheated to 700 deg. at approximately 100 lb. pressure, and led to the 43,000-kilowatt low-pressure unit, running at 1200 revolutions per minute.

The American Gas and Electric Company has on order eight 35,000-kilowatt—1800 revolutions per minute units to be installed in three different large power plants. These units are designed to operate at from 600 lb. to 550 lb. pressure, 725 deg. steam and 29in. vacuum. Reheating up to 725 deg. is done at 100 lb. pressure.

Two 40,000-kilowatt, 1800 revolutions per minute units are also on order for the Columbia Gas and Electric Company, Cincinnati, Ohio.

One 3000-kilowatt turbine is also being built for the Edison Electric Illuminating Company of Boston, to be installed in its new Weymouth station. This turbine will operate at 1200 lb. pressure, 725 deg. steam, exhausting into the 350 lb. station main, and is designed to handle about 130,000 lb. of steam per hour.

IT is believed that the Barnsley seam will be struck at Thorne Colliery at a depth of 910 yards. The Kent thick has already been passed and is 5ft. 2in. thick.

British Wire-drawing and Wire-working Machinery.

No. I.—THE MANUFACTURE OF WIRE RODS.

FROM time to time there have appeared various articles and papers dealing with the manufacture of wire and the machines used in its production, but the majority of writers have confined themselves to the history, or some individual section of the industry, and we believe that there is no single work dealing comprehensively with the great variety of trades dependent on wire as a raw material.

In view of the vast extent of the industry and the fascinating nature of many of the machines it involves, it is proposed in a series of articles to deal as comprehensively as possible with wire-working machinery as used in this country. (We say as comprehensively as "possible," because some of the trades concerned are so closely guarded that it is very difficult to obtain information, but we hope to give a rough outline even of some of these secret processes.)

The subject naturally divides itself up into two distinct sections, the first being concerned with the production of the wire and the second with its conversion into a wide variety of useful objects.

In connection with the first section, we do not propose to go into the history of the industry to any extent, as it has been dealt with by several writers; but it is noteworthy that although the use of wire is referred to in some of the earliest writings, the modern system of wire drawing is of quite recent introduction. In Biblical days wire was made by cutting sheet metal into strips and hammering them on an anvil to reduce them to the required thinness. Obviously, only short lengths could be produced by this process.

There are some brief references to the drawing of wire through a die, instead of hammering it, which date back 900 or 1000 years, while it appears that there were some wire-drawing establishments in Paris in the latter half of the thirteenth century. It is generally conceded, however, that wire drawing, as an important industry, only started about the year 1350 on the Continent, and that it was not introduced into England until the reign of Queen Elizabeth.

The substitution of rolled rods for hammered rods greatly facilitated the process of wire drawing, but it was only about fifty years ago that a continuous wire drawing machine was evolved by Mr. A. Thornton, of Manchester. Since that time various improvements have been made in the machines, but they still possess the same general characteristics. It is satisfactory to note that although continental industrialists played such a prominent part in the early history of the industry, it was an English inventor who made one of the most important steps in its development.

As to machines for working up wire into useful articles of commerce, there is not much historical information; but there are still in service machines which were used at the time of the Crimea War for making military accoutrements from wire, while Queen Elizabeth possessed a factory for making pins from wire. Nowadays, there are vast numbers of machines for working up wire, ranging from the delicate apparatus used in fashioning needles to massive looms making wire mesh from material ½in. in diameter.

Before describing the process of wire drawing, it may be as well to make some reference to the raw material from which the wire is drawn.

Since very little iron wire is now made, wire may be roughly classified as steel or non-ferrous. The preparatory processes for the two classes are generally distinct, although with some non-ferrous metals, such as the nickel alloys and copper, there is a close resemblance to the practice with steel.

The rods from which brass wire is drawn are generally produced by slitting flat bars. The bars are passed between rolls provided with sharp-edged grooves that shear the metal into long square section strips. The work requires considerable skill and attention on the part of the men in guiding the bars through the rolls, but even with care a large amount of scrap is produced through the strips tapering away or breaking off into short unusable lengths. The square strips are passed through rolls to round them off and reduce their section somewhat, and are then passed on to the annealing and drawing departments.

STEEL WIRE ROD.

For the production of the rods used in making steel wire much more elaborate equipment is the rule.

The billets from which the rods are rolled are generally brought from outside, and we do not propose to pursue the subject further back than the arrival of the billet at the mill, as it appears that most works rely on the experience of the steel makers for the quality of the material, although some of those which we have visited systematically analyse samples of the steel they use. It appears, in fact, that the quality of the ultimate product is as much dependent on the treatment the metal receives in rolling and drawing, as on the chemical composition of the metal itself, although it is obvious that good wire cannot be made from bad billets.

There are three types of wire rod rolling mill in this country, and a typical example of each of the three is to be found in the works of Wm. Cooke and Co., Limited, Tinsley, near Sheffield, and the Associated Templeborough Rolling Mills Company, Limited.

The first of the three styles of mill just mentioned comprises a set of rolls, generally all coupled in line, through which the billet is passed in succession, being man-handled between each pass; but, on account of the large amount of labour involved in working by this system, it is being rapidly superseded by more modern methods, and it is not necessary to enlarge upon it here.

The looping mill, which comes next in date of origin, was first developed in Belgium, and effects a great saving of labour. The looping, or No. 2, mill at Messrs. Cooke's, which is illustrated by the accompanying engraving, Fig. 1, comprises three distinct trains of rolls all driven by ropes from a fine cross-compound Marshall steam engine of about 1800 horse-power—see Fig. 2. In this connection it is noteworthy that it is very important that the speed of the drive should be kept as nearly uniform as possible, as variations may affect the quality of the rod on account of differences in the temperature as it passes through the rolls. There is a steam recorder in the engine-room, and the stokers are urged to maintain as constant a steam pressure as possible.

The three trains of rolls comprise a cogging mill, an intermediate set and a finishing mill.

The cogging mill does not require much comment, as it follows ordinary mill practice. In it billets about 3in. square are rolled down to about 1¼in. square, and they are then passed directly by hand to the intermediate mill. The intermediate rolls are two-high, and the rod is generally given two passes here, but it is not handled in the process. Directly behind the groove in the roll, through which the bar passes, there is a "repeater," or curved guide that leads the rod into the next pass.

The two successive pairs of rolls run at the same peripheral speed, but the rod is naturally lengthened as it goes from pass to pass. In other words, the rod must emerge from the rolls at a greater lineal speed than it is drawn in, as it not only takes up the speed of the rolls themselves, but is also squeezed forward by an amount corresponding with the reduction in cross-sectional area. As a result, a greater length of rod is fed out from the first pass, in a given length of time, than is drawn in by the second pass. This increase in length could not be accommodated in the repeater if it were a closed duct, so the bottom side—it is square in cross section—is left open, and as soon as the rod coming from the first pass begins to crowd up against the second pass, it jumps out of the repeater through the opening and extends as a loop on the floor. When the back end of the rod comes out of the first pass, the loop trails round an iron stump or fair lead in the floor so that the end is guided towards the second pass.

From the intermediate rolls the rod is guided into the finishing mill, and here, again, no attendant is required. The repeater in this case, however, takes the form of a plain closed pipe, as no extending loop is allowed to accumulate. The two mills are driven separately, and the peripheral speeds of the two sets are so adjusted as to take up all the slack of the rod as it is produced. From this point onwards, the rod is taken from pass to pass by hand, and it is surprising how dextrous the men become in snatching the end of the rod, in tongs, immediately it appears through the rolls and entering it in the guides of the next pass.

There is a very considerable extension of the rod at each passage through the finishing rolls, and the resulting loop is accommodated in long troughs, which extend as inclines below the floor plates. The rod, in fact, becomes so long that it is frequently being worked upon simultaneously by three pairs of rolls.

After going through the last pass, the rod, now about $^{3}/_{16}$in. or ¼in. in diameter, is taken to a coiling machine, and wound on a horizontal swift. This machine is driven by a variable-speed electric motor, so that the attendant can just keep pace with the mill and not stretch the rod in coiling it up; but generally there is ample slack on the floor to obviate such an occurrence. When the rod emerges from the finishing train the end is caught in a hook by a boy, and he guides it on to the floor in big figures of eight, just as if he were a gardener watering the lawn with a hose, and it is not until several loops have accumulated that the first end is taken to the coiling machine. Just as the last end of the rod emerges from the mill, an attendant chops off the end with a big hatchet for sampling purposes. The coils are pulled off the winder

FIG. 1—THE NO. 2 LOOPING WIRE ROD MILL AT TINSLEY

by hand, and are hauled away to cool down before being sent to the stock yard.

The speed of these mills is really astonishing to anyone used only to heavy rolling mill practice, as they run at a speed of some 400 revolutions per minute, and have a peripheral speed of from 1200ft. to 1300ft. per minute. The result is, as we have suggested, that the rod is projected from the mill just like a stream of red-hot water.

This high speed is an important factor in the operation of the mill, as it not only increases the output, but also has a great bearing on the uniformity of the rod throughout its length. The back end of the rod has, of course, been longer out of the furnace than the front end, when it goes through the last pass, and as a consequence is not rolled quite so small. The difference in finishing temperature also has an effect on the physical characteristics of the rod, which is found to increase gradually in hardness from the beginning to the end of the coil. The maximum stress of the material at the end of the rod may be as much as 1½ per cent. greater than that at the beginning, while the elongation on fracture is correspondingly reduced. This variation in quality may appear to be slight, and can be eliminated by subsequent normalising, but it is in the interests of the rod maker, from all points of view, to keep the speed of rolling as high as possible.

The wear and tear on rolls subjected to such service as that just described is naturally severe, and they have to be made of the very best material. Some are of cast steel, but chilled cast iron seems to be preferred. The diameter ranges about 12in., and the length is approximately the same. Each roll is provided with several grooves, all of the same size, so that they can be used in succession, as they wear out, without it being necessary to change the rolls.

In the course of reducing round sections by rolling it is not, of course, possible to maintain a round section throughout the several passes, as such a process would only result in fins being squeezed out on either side, and these fins would subsequently be bent over and form "cold shuts" in the rod. It is consequently necessary to vary the shape of cross section from pass to pass. The actual variations depend on the rate of reduction in area required, but generally they comprise combinations of squares, ovals and rounds in sequence, naturally finishing with a round.

The change in the section of the rod during the finishing pass gives the roller a good opportunity of judging, at a glance, the accuracy with which the rolls are set. In this pass an oval is converted into a round, and the resulting rod will have flattened sides or fins, according as to whether too much or too little is delivered to the finishing rolls from the previous pass. The adjustments in this direction are very important, as the wire drawer naturally wants to be supplied with round rods, while, unless the rod is worked upon by the rolls equally all round its circumference, there will be hard and soft spots in its cross section.

The rod has to be offered up to the groove of each pass very precisely, as an oval, for instance, must not lie on its side as it enters a round groove. As a consequence, the guides have to reach right up between the rolls and terminate in a fine point, so that the rod is supported as close to the rolls as is possible. Any damage to the point of the guide is fatal to its proper working. The guides are fixed between the housings in the usual manner adopted in rolling mills, and are adjusted by means of wedges.

The rods generally turned out from the Tinsley works are of No. 5 gauge, or about 0.22in. in diameter, which appears to be the most favourite size among wire drawers. The output of the mill we have just described, together with the older No. 1 mill, is some 60 tons per ten hours' shift. Figs. 3 and 4 illustrate a new pusher furnace for heating billets installed in the No. 1 mill by the Harvey Siemens Furnace Company.

The third class of wire rod rolling mill referred to earlier in this article is the continuous type developed in America by Morgan, the principle of which was invented in Manchester by George Bedson as long ago as 1862. A very full description of the Morgan equipment of the Templeborough Rolling Mills, Limited, appeared in THE ENGINEER of June 20th, 1919, but it may be as well to give here an outline of the scheme, as it results in such a great increase in output without involving any heavy manual labour. The general arrangement of the mill is given in Fig. 5.

In the Morgan system of rolling the sets of rolls, instead of being arranged in a long line, lie paral el with one another and are close together, so that the rod goes directly from one pair of rolls to the next,

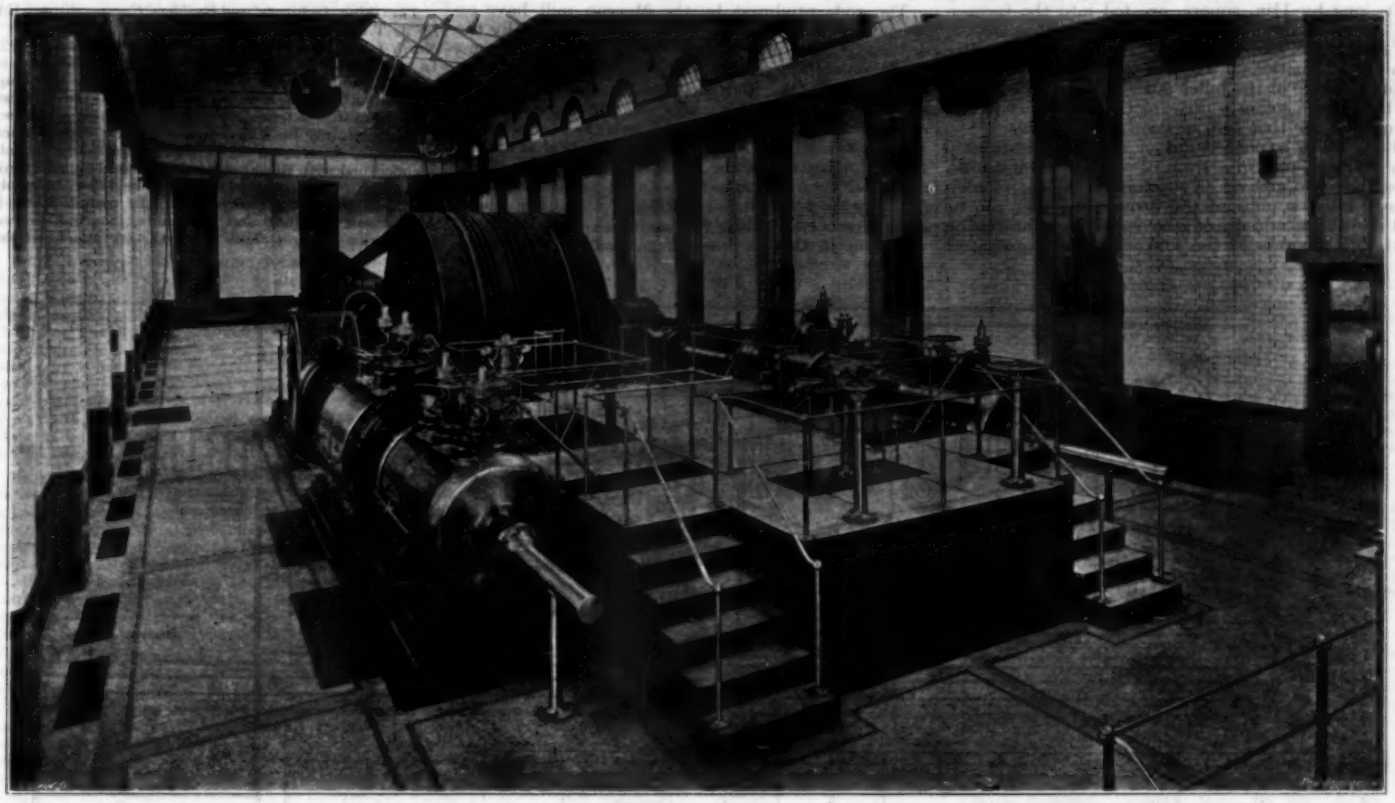


FIG 2—1800 HORSE-POWER ENGINE DRIVING NO. 2 ROD MILL

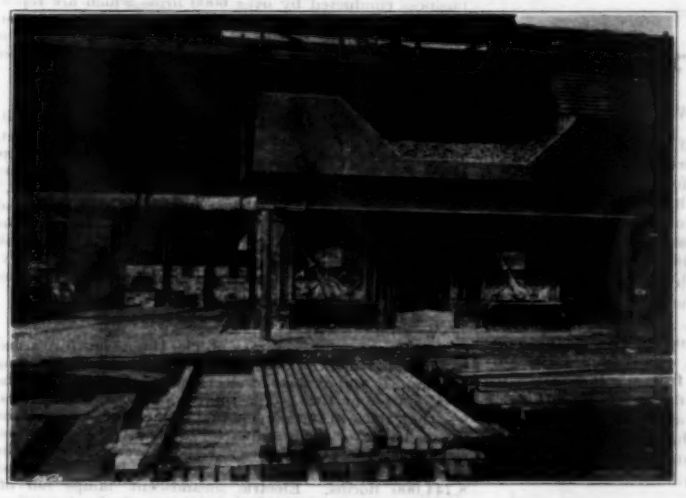


FIG. 3—BACK OF PUSHER FURNACE, NO. 1 MILL

FIG. 4—FRONT OF FURNACE, SHOWING DRAWING DOORS

In order to accommodate the increase in the length of the rod, as it is reduced in section, each pair of rolls is driven at an appropriate speed. The drive is taken from a common shaft through bevel gearing, but each set of gears has a different ratio. By adopting this arrangement, it is possible to roll the rod at a very high speed, and it goes through the final pass at a rate of some 2800ft. per minute.

The arrangements for reducing manual labour are very elaborate, and although several attendants are required, they are not called upon to do any really hard work. The billets, which, by the way, are much thinner than those used at the looping mill, being 30ft. long by 1¾in. square, are fed into the furnace by live rollers, and are pushed out again, when heated, by a machine. In this connection, it is noteworthy that all instructions in the mill—such as those to the man in charge of the billet pusher—have to be given by blasts on a steam whistle, as the machinery makes so much noise that conversation is impossible.

Each billet is pushed out of the furnace directly into the first pair of a train of seven roughing rolls. There are two grooves in these rolls, so that so soon as one billet is clear of the furnace, another can be fed into the second set of grooves without interfering with the progress of the first, and the capacity of the mill is virtually doubled by working, as the expression is, "double strand." The space between the furnace door and the first roll is a matter of only a foot or so, and in this space there is a set of toggle shears which can be used to cut off the billet in the event of any mishap in the mill. From the roughing train, the rod goes to the intermediate rolls, four in number, and driven by the same engine. Between the two units there is a set of flying shears, which is used to snip off the end of the bar as it passes, in order to give it a good clean end for entering the next pass. These shears can, of course, also be used to sever a defective or damaged bar.

From the intermediate rolls, the bar goes to the finishing set, of which there are six stands, arranged in two groups, of two and four pairs of rolls. The finishing train is not in line with the intermediate set, and the rod is guided into it by a repeater of a different pattern from that already described in connection with the looping mill. This repeater—see Fig. 6—is open at the top and on the inside of the curve, but is provided with two undercut grooves for guiding the rod, which jumps out at the top of the repeater and can extend, as a loop, up and down a long incline.

FIG. 6—DIAGRAMMATIC SECTION OF REPEATER BAR

The reason for introducing this repeater is the fact that there are two engines for driving the mill. One, of 1700 horse-power, works the roughing and intermediate rolls, while another, of 1100 horse-power, drives the finishing train. Both engines are by Yates and Thom. It should be mentioned, incidentally, that steam engines were installed at Templeborough as a wartime expedient. Normally, mills of this type are driven by electric motors, and there seems to be a general tendency to adopt that form of drive in all machinery connected with wire working. If it so happens that the two engines are not adjusted to run exactly in unison, the rod will be rolled more, or less, quickly in one set of the rolls than in the other, but any difference in the rate of feed is taken up in the loop formed by the repeater. Generally speaking, however, the rod hardly leaves the guiding groove of the repeater. Another similar device turns the rod back again and leads it into the final set of four finishing rolls, from which it goes to an automatic reeling machine, and is taken away by a conveyor on which the coils cool down sufficiently to be loaded into railway trucks.

At the time of our visit to Templeborough No. 5 gauge wire rod was being rolled, and it took just 50 seconds to complete a coil of 300 lb., while the consistent output was 120 coils per hour—the mill was working double-strand.

The rods produced by the Morgan mill have an appearance slightly different from those made by the ordinary rolling mill, as the mill scale on them seems to be more adherent, a peculiarity which is to be accounted for by the greater amount of handling which the ordinary rods receive, as compared with the rapid and uniform progress through the Morgan mill. Inquiry among wire drawers did not show that special favour for one rod or the other exists, although it was admitted that the smaller amount of scale on the ordinary rod facilitates pickling. Another slight difference between the two classes of rods is the lesser variation in the hardness from end to end of the Morgan rods, a characteristic easily accounted for by the higher speed of rolling.

The great extent of the wire rod rolling industry may be gauged from the fact that the one firm of Wm. Cooke and Co., Limited, alone produced 40,000 tons of rods per month during the comparatively quiet times of 1922–23.

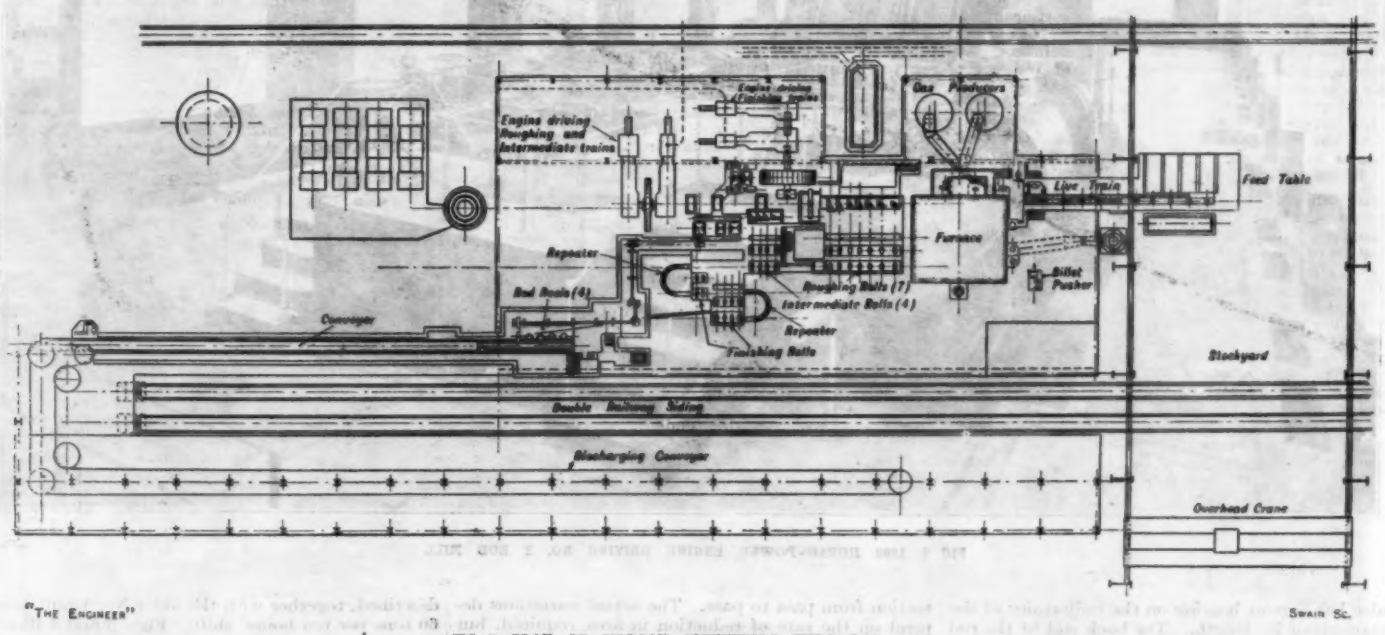


FIG. 5—PLAN OF MORGAN CONTINUOUS WIRE-ROD MILL

Obituary.

GEORGE FOWLER.

THE death is announced of Mr. George Fowler, as having taken place at Brighton on Saturday. Mr. Fowler, who was seventy-four years of age, was, right up to the time of his death, an active director of Hick-Diesel Oil Engines, Limited, of 70, Queen-street, London, E.C. 4, and was one of the pioneers of the Diesel engine in Great Britain, it being he who originally purchased the British and American Diesel engine patent rights and formed the original Diesel Engine Company in England. He was from those early days up to the time of his death actively connected with the Diesel engine, which he always considered to be the engine of the future. It was, we are given to understand, entirely owing to his influence that the firms of Sulzer Bros. and Carels Frères first took up the manufacture of the Diesel engine. Mr. Fowler, in addition, was a pioneer of the drop valve steam engine in Great Britain.

BOOKS OF REFERENCE.

Kelly's Directory of the Merchants, Manufacturers and Shippers of the World, 1924. In two volumes. 64s. post free. London: Kelly's Directories, Limited, 186, Strand, W.C. 2.—We have before us the thirty-eighth annual edition of this directory, which every year increases in size. The two volumes now contain nearly 5000 pages. In them we find information about nearly 20,000 foreign and colonial cities and towns, whilst one and a-half million trade descriptions are given. The first volume deals with foreign countries and their dependencies, and the second is devoted to all land under the flag of the British Empire. For each of the foreign towns and cities, carefully classified lists are given of those engaged in trade and commerce, with the classes of goods in which they deal. In the section devoted to Great Britain and Ireland, classified trade lists are given for:—(1) London and its suburbs; and (2) for the rest of the country. In the present edition there is an alphabetical list of the telegraphic addresses of the individuals and firms whose names appear in the section devoted to Great Britain and Ireland. The use of the book is considerably simplified by a concise explanation of its arrangement, by an excellent index and by a practical example of how to use it, which will be found, in four languages, just after the title page.

The China Architects' and Builders' Compendium. Edited by J. T. W. Brooke and R. W. Davis. Shanghai: The *North China Daily News and Herald, Limited*, 1924.—In the preface to this first edition the editors point out that no such reference book has before been compiled for China, although in other countries similar works have been in existence for many years, and the new one should certainly be added to the library of engineers, or architects, interested in China. The present volume is concerned with the conditions of Shanghai and Hankow, but much of the information may be taken to apply to the Yangtze Valley in general. It includes the local regulations, weights and measures, bearing power of soils, prices, wages, and so forth. A short article on artesian wells suggests that the day of deep wells in China is just beginning. The compendium is to be published annually.

Manchester Royal Exchange Directory, 1924. Manchester: Richard Collinson, Limited, 9, Corporation-street, and John Heywood, Limited, Deansgate. Price 21s. net.—This official guide gives information of the business conducted by over 6000 firms which are represented on 'Change. This, the twenty-ninth edition, has been entirely revised, and the classification of the cotton trade has been re-arranged. The telephone numbers of town and country firms are included.

The Railway Year-book for 1924. London: The Railway Publishing Company, Limited, 33, Tothill-street, Westminster, S.W. 1. Price 5s. net.—This volume is now in its twenty-seventh year of publication, and continues to be known as the "Whitaker of the Railway World." New maps of the grouped lines have been prepared, and the statistics of the "big four" are presented for the first time. The work entailed in compiling the book under the new conditions of grouping has been heavy. All details are brought up to date of the time of going to press.

THE Commercial Secretary at The Hague has forwarded to the Department of Overseas Trade particulars regarding the imports and exports of electrical apparatus during the first quarter of 1924. The total imports were in general less than those of the same period in the previous year, the figures being for the first quarter of 1924 4,810,000 florins, as against 5,995,000 florins. Exports were also less, the comparative figures being 7,980,000 florins, against 8,744,000 florins. Electric incandescent lamps fell off to the extent of 850,000 florins. France, Italy, Argentine, Australia and Belgium were the largest customers.

A STATIC condenser consisting of a number of condenser units, a reactance for damping out the higher harmonics in the voltage wave, a discharge resistance for draining the condenser charge when disconnected from the line, and an oil circuit breaker for the control of the equipment, has been developed by the American General Electric Company. Each unit is composed of a large number of couples of metal foil with paper laminations as a dielectric. These units are mounted on a rack and in larger capacities the complete units are arranged in tiers or banks. The losses in the 2300-volt equipment are approximately one-half of 1 per cent. of the kilovolt-ampere capacity. In the case of low-voltage equipments, where a transformer is included, the losses are approximately 3 per cent.

Railway Matters.

SOME apparently justified complaints as to overcrowding in long-distance trains were made in questions addressed to Mr. Gosling on the 1st inst. The Minister replied that aggrieved parties could, by organisations or through local authorities, go to the Railway Tribunal and find a remedy.

IN the days of the separate existence of the London and Birmingham, the railway works at Wolverton built and repaired locomotives, carriages and wagons. Under the London and North-Western, eventually only carriages were built there; wagons were built at Earlstown. Now, under the London, Midland and Scottish, wagons are again being constructed at Wolverton.

WHEN the cost of living began so seriously to increase in the later months of the war, the very hard case of railway superannuitants was frequently mentioned in this column. Relief was subsequently afforded by voluntary grants from the companies, and from the active members of the superannuation funds. The London, Midland and Scottish Railway has, as a consequence of grouping, had to modify its fund, and for this parliamentary sanction was necessary. This afforded the superannuitants an opportunity to secure permanent relief, and after rather a bad time in Committee on the Bill, the Company has increased its gift of £48,000 a year to £78,000.

THE summer train services came into operation on Monday last, the 14th instant, but do not provide a single instance worthy of being mentioned as setting up a new departure as to speed, long distance non-stop or new routes. The main changes have already been mentioned in our columns, *e.g.*, the re-casting of the Great Western time-table, the whole of the London-Portsmouth service given by Waterloo and none by Victoria, the Stranraer boat trains travelling by the Midland route to Carlisle instead of over the London and North-Western, and the midnight Glasgow express from Euston journeying *vid* Dumfries and Kilmarnock instead of Beattock and Carstairs.

THE officers in charge of the annual meeting of the National Union of Railwaymen last week had a difficulty in keeping control over some of the delegates when the question of the nationalisation of railways was being discussed. In the end the matter was referred to the Standing Orders Committee, which drafted the following resolution:—"This congress welcomes the grouping of the railway companies into four groups as a step in the right direction, and decides to call upon the executive of the union to frame a Bill to be submitted to Parliament, having for its object the nationalisation and democratic control of the railways of this country." The resolution was carried by a large majority.

THOSE railwaymen who received their war training at Longmoor will regret to hear of the death, on the 10th instant, of Colonel H. M. Sinclair. Colonel Sinclair, after thirty-eight years' service in the Royal Engineers, retired in 1912, but came back when war broke out, and in the later months of 1914 went to Longmoor as Commandant Railway Troops. That he did good work there was shown by his request to be sent overseas never being complied with. Those who are reading our articles "One Hundred Years of British Railways," will be interested to hear that Colonel Sinclair was a grandson of the Sir John Sinclair of the Board of Agriculture, whose name has been mentioned in connection with early tramroads.

THE only living link with the world's first railway engine is said to be Mr. John Cowley of Belmont-gardens, West Hartlepool. Mr. Cowley, who is in his eighty-third year, served as a fireman on George Stephenson's famous locomotive No. 1, which ran on the Darlington and Stockton Railway. He was engaged, when a youth, on the building of the Durham Railway Station and the viaduct which spans part of the city. The stone required was brought from Leamside and, owing to the inability of the engine in use to haul this stone, application was made to Darlington for another. Locomotive No. 1 was sent with a driver, but no fireman. Mr. Cowley offered his services and for one day "fired the historic engine."

THE annual meeting of the National Union of Railwaymen was held in York last week, where the Lord Mayor for the present year is himself a railwayman. Among the matters discussed was the Washington Convention resolution as to the forty-eight hours' week. Were this resolution passed into law the railwaymen would be very badly hit, as time worked by trainmen, signalmen, porters, &c., on Sundays would have to be "played off" during the week. The companies themselves would be much inconvenienced, as many permanent way repairs, relaying, signal alterations, &c., have for safety's sake to be carried out on Sundays. A letter from Lord Henry Bentinck, in *The Times* of the 12th instant, pointed out that Article 6a of the Convention would appear to exempt such Sunday work, as it provided that "permanent exceptions may be allowed in preparatory and complementary work which must necessarily be carried on outside the limits laid down for the general working of an establishment."

THE Melbourne correspondent of *The Times*, cabling under date July 2nd, anticipates that the Federal Government will accede to the requests of the South Australian authorities as to building some further portion of the North-South Transcontinental Railway. Serious opinion in Australia very much doubts the wisdom of this undertaking. Each State has large areas of land outside its larger towns which it wishes to see occupied. The majority of the white population of the Northern Territory live in the one large town of Darwin; elsewhere there is an average of only one white man per thousand miles. In most parts the climate is sub-tropical and tropical, and has been well likened to the Sudan. Moreover, the law of the land says that Australia must be white. There, thus, is the question: Who is to reside in the Northern Territory? Unless it be populated, a transcontinental railway will be of no use; its existence could only be justified on the grounds of rail communication with Darwin. Neither will it be of the same service for the carriage of mails as the east-west continental, as to call at Port Darwin and then send the mails 1000 miles across the continent would cause them to arrive in Adelaide, Melbourne and Sydney later than they do to-day.

Notes and Memoranda.

THE damming work now in progress at the Grande Décharge, Lake St. John, constructed for the Quebec Development Company, should be completed in December, 1925. A maximum development of nearly 1,000,000 horse-power will be available.

PUBLIC opinion in Melbourne appears, according to the *Commonwealth Engineer*, to be growing in favour of the suggestion that no trams should be laid down in the central city area. The proposal of the Tramway Board is to employ overhead trolley cars in place of the present cable system.

IN his annual report Dr. F. W. Alexander, the medical officer of health for Poplar, states that electrolytic fluid is still in great demand by the public. During the year 64,740 gallons were manufactured and broken down to 129,480 gallons for distribution. Since the installation of the Poplar electrolytic plant eighteen years ago 749,349 gallons have been manufactured at a cost of £1147 for electricity and £1442 for materials.

IN the early days of German gas engineering it was common practice to encase the gas holders with a brick structure. It is reported that one of the disused brick gas holders in Berlin is to be converted into a motor garage by a private company. The holder is large enough to permit of ten floors being built into it which will be served by a spiral roadway 25ft. wide encircling the building. Each floor, it is stated, will be large enough to accommodate 100 cars and 50 motor cycles.

TWO French engineers, MM. Perrineau and Robert, have been experimenting with the sea muds in the estuaries of the Loire and the Gironde. They found that if dried by exposure to air, or in kilns, freed from sand and organic —vegetable—matter and then finally ground, the resulting powder can be added in large proportions to suitable lime for the manufacture of cements. Such cements are slow setting, show a high resistance to atmospheric moisture and water, and are highly impermeable.

A METHOD for conducting an oxidation test on lubricating oils has recently been developed at the United States Bureau of Standards. This consists in exposing a sample of the oil in a closed flask filled with oxygen to a temperature of 200 deg. Cent. for 24 hours. The precipitate thrown out by a definite solution of the oxidised sample in petroleum ether is determined. The mass of this precipitate expressed as a percentage of the original sample—10 g.—is taken as the oxidation value.

NOT many years ago, writes the *Electrical Times*, few valves, however large, were controlled by electric motors. There is now a growing tendency to govern all important valves, whether for steam or water, in this way. In the States it is carried out with characteristic thoroughness, and at one large station there is a sort of diagrammatic control board with push-buttons corresponding to all the master steam valves. By means of this steam pipe switchboard, any given section can be cut off or coupled in on emergency, and the whole state of affairs can be seen at a glance.

ACCORDING to Mr. S. L. Pearce the maximum sizes of steam turbines are likely to be 50,000 kilowatts for the single-cylinder type, operating at 1500 revolutions per minute, with a preference for a limitation to 30/35,000 kilowatts. Above 50,000 kilowatts certainly, and probably above 35,000 kilowatts, the turbine unit will be of tandem construction or of the cross-compound design. Speeds, again, exercise a vital influence on the type or design. The largest unit operating in America to-day is of 60,000 kilowatts capacity, and in this country 30,000 kilowatts. Sets of 35,000 kilowatts are, however, being built for a new London station.

AMONG the advantages claimed for the construction of wagon and other wheels, gears, &c., by the Stroh process is that the hub and body may be of any desired metal, cast steel of low or high carbon content, while the tread and inside of the flange or flanges which are subject to wear and shock are of the hardest alloy known in metallurgy. The flanges cannot fracture and the tread will not peel off. This wearing surface, says the Stroh Steel-Hardening Process Company, of Pittsburg, U.S.A., the originators of this method, is an integral part of the casting, of known and controlled depth and character, wearproof, and having a high elastic limit.

THE New South Wales Board of Trade has announced its determination of the conditions of apprenticeship in the metal moulding trade. They are as follows:—The term of apprenticeship for minors between fourteen and seventeen years of age shall be five years, and for those who by consent enter the trade after attaining seventeen years the term shall be as the Board may order. All shall be taught, among other things, jobbing moulding and hand core-making, and, if directed, shall attend a technical college or other approved school for not less than four hours a week for two years. The minimum scale of weekly wages shall, subject to periodical declarations by the Board, be:—First year, 17s. 6d.; second year, 25s.; third year, 32s. 6d.; fourth year, 40s.; fifth year, 52s. 6d. No apprentice shall be employed continuously for more than three months on repetition work.

AT the sixteenth annual Congress of the Tramways and Light Railways Association, Mr. W. Nairn read a paper on "Overhead Equipment." From the engineering standpoint, he said, the fault of the original poles was over-ornamentation, the ornaments in many cases being unprovided with water sheds and seals to prevent the accumulation of moisture and consequent corrosion. Of the three types of construction—span wire, side bracket and centre poles—the span wire system was the most satisfactory where the streets were not above normal width, as it gave centre running with maximum flexibility. On wide streets which were straight, centre poles were equally good, but where there were curves pull-off poles must be added on one side. Bracket arm work was only suitable for narrow streets, and in both centre-pole and bracket-arm construction it was desirable to build all junction work on spans, as this system alone allowed of the requisite pull-offs and anchors.

Miscellanea.

THE Wolverhampton Corporation's electricity department made a gross profit of nearly £84,000 last year.

THE second Wireless Exhibition is to be held in the Albert Hall from September 27th to October 8th inclusive.

THE bridge which is to be built over the Ouse at Boothferry will link up Goole and Howden and the developing districts round those towns.

IT is estimated that 200 men will be employed at Howden on the construction of the five million cubic feet airship for the Egypt and India service.

THE Gloucestershire County Council is applying for the necessary order for abandoning the Thames-Severn Canal as from March 25th, 1925.

ALTHOUGH the Mauretania was handicapped during her last homeward voyage by having one of her four propellers out of action, she was able to maintain a speed of 24.18 knots, which is less than one and a-half knots under her record speed for the voyage.

THE first box of coal was raised on June 20th from No. 1B, the Dominion Coal Company's newest colliery at Glace Bay, Nova Scotia. The pit has cost nearly 3,000,000 dollars, has a normal annual capacity of about a million tons, and is exclusively an undersea mine.

A NEW seam of coal of excellent quality has, says *Canada*, been found on the Carter areas at Macoan, Nova Scotia. The principal seam is 43in. in thickness, while just above, and separated by only a few feet, is another seam 36in. in thickness, which will make a working seam of 79in. of coal and may be handled from one shaft.

OVER thirty mining areas in Anhwei, China, have been staked out by the Director of Anhwei Mines for exploitation. A coal mine at Yin Chia Wei, in Kweishih, yielding anthracite coal and another at Suitung, in Hsuancheng, producing bituminous coal, have been prospected and are to be worked immediately. The Mining Director is raising a public loan to work the mines.

THE Tasmanian Public Works Department proposes to construct the Ralph's Bay Neck Canal. Ralph's Bay is an inlet of the Derwent estuary, and a narrow neck of land separates it from Frederick Henry Bay. The canal will be about 1 mile 22 chains in length, with a depth of 10ft. below low-water mark, a width at the bottom of 30ft., and the sides on a slope of 3 to 1.

IT is understood that Sir John Snell has made a preliminary and private report to Mr. Sidney Webb, President of the Board of Trade, with regard to the Severn barrage scheme. It is not intended that this report, which is at present being considered by the Government, shall be published, but it is learned on good authority that on the whole it is in favour of the scheme.

WHAT is said to be one of the largest wireless frame aerials in Europe has been erected on the roof of the Bush Building, Aldwych, W.C., by the United States Shipping Board to conduct the business between London and the United States. It is 8ft. by 8ft., and is wound with 48 turns of wire. Mounted on ball bearings, it can be made directional from the interior of the building by a wheel similar to the steering-wheel of a motor car. Messages can be received from places 8000 miles distant.

WORK on the development of the Consett Iron Company's Humber Hill Estate, which overlooks the villages of Knitsley and Lanchester, is progressing rapidly. The royalty which the firm acquired, covers 500 acres, and underneath this area at least three seams of coal have been found, and there is every possibility of a fourth. A new drift has been opened out, and it is fitted with electric appliances for working and drawing coal. The drift is connected with Crookhall Victory Pit, Consett, and communication between these two collieries, a distance of nearly four miles, has been established by a tramway, worked by two powerful electric hauling engines.

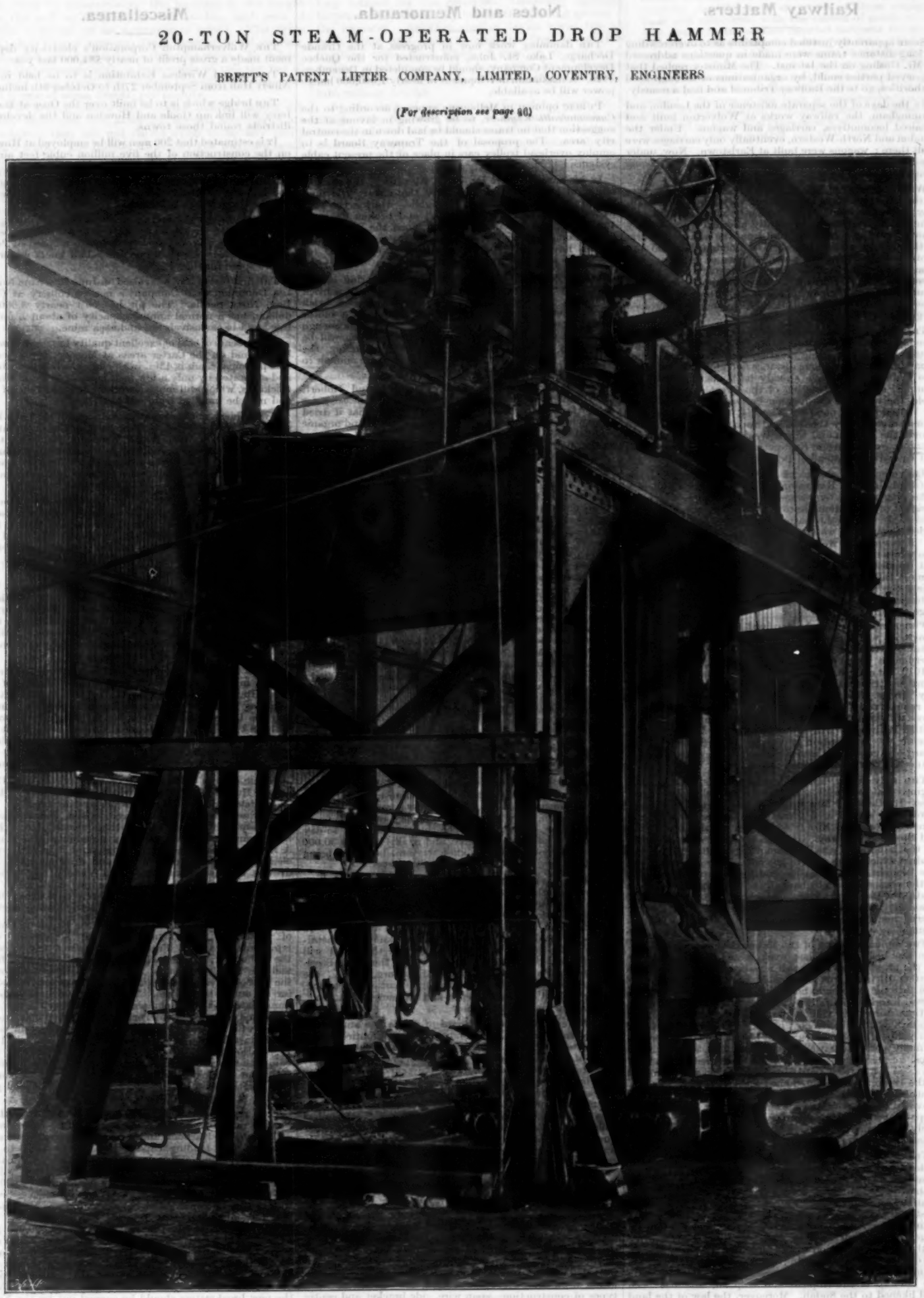
IT is reported from Warsaw that the Russian Minister of Commerce has signed a fiscal agreement with representatives of a Franco-Polish group, composed of the Schneider, Creusot, Batignolles and Hersant firms and the Polish Industrial Bank, for the construction of the port of Gdynia near Danzig, the site assigned to Poland for an outlet to the sea. The work, which is to begin immediately, is to be completed by January, 1930. The estimated cost of the enterprise is 35,000,000 gold francs, which will be paid by the Polish Government in seven yearly instalments, the first payment to be made in 1927. It is also stated that an additional contract for port equipment, such as cranes, &c., will be signed shortly with the Schneider and Creusot firms, the estimated cost for this supplementary work being 15,000,000 gold francs. The depth at the port will be 33ft.

IT is reported that the Yokohama municipal authorities are now drawing up plans for a further enlargement of Yokohama Harbour under a fourth period expansion scheme. The landing capacity of the harbour to-day is 9,500,000 tons, and upon the completion of the third period expansion scheme, now in progress, there will be an addition of 2,500,000 tons, making a total of 12,000,000 tons. Under the fourth period expansion scheme, breakwaters will be constructed between Juniten, Hommoku, and the entrance to the Tsurumi River, Tsurumi. The new enterprise, it is estimated, will cost 65,000,000 yen. (The par value of the yen is just over 24½d.) The Yokohama municipality will approach the Central Government with a request that it undertake the construction of new breakwaters between Juniten and the Tsurumi River, on condition that all other necessary arrangements inside the new breakwaters should be carried out by the Yokohama Municipality. Further, the Yokohama authorities will undertake the reclamation of the sea front near the entrance to the Tsurumi River to the extent of 650,000 tsubo—1 tsubo = nearly 4 square yards—of which 200,000 tsubo will be utilised for the construction of roads, a canal, &c. The remaining 450,000 tsubo will be rented to individuals and companies for the construction of factories and workshops. From this particular source the Yokohama authorities hope to obtain a revenue of 1,620,000 yen annually.

20-TON STEAM-OPERATED DROP HAMMER

BRETT'S PATENT LIFTER COMPANY, LIMITED, COVENTRY, ENGINEERS

(*For description see page 80*)



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THE ENGINEER.

JULY 18, 1924.

The World Power Conference.

THE conference habit is one to which mankind is now firmly addicted. Apart from the attempts to settle the economic problems of the world by means of recurring conferences—which is a habit of post-war politicians—the technical and business man has shown signs of falling more and more under the spell of conference organisations. We have had in rapid succession in London national or international gatherings of shipowners and shipbuilders, those connected with the textile, mining, and metallurgical industries, and have gradually worked up to the super-conferences of world power and advertising. There is indeed a touch of advertising about the whole business. What has happened during the present year is partially explained no doubt by the holding of the British Empire Exhibition and the general desire to make a real success of that great enterprise. If that end could be brought about by a torrent of papers and a deluge of discussions on a vast variety of topics and by the presence in England of leaders of the many industries with which recent conferences have been concerned, it might be regarded as already achieved. From some points of view, the conference habit is to be commended. It certainly has the effect of bringing together for a brief period those engaged in the same class of work in different countries, and altogether apart from the value of formal discussions, these occasions provide opportunities for informal talk and interchange of opinions which must tend to break down the barriers imposed by difference of nationality and self-interest. Competition and rivalry there must always be, but it is possible at gatherings such as those of which London has been the centre during the last few months to fix lines of advance along which all countries can march together and to pool for the benefit of the world as a whole the results of scientific work which stand outside the confines of trade reserves or national possession. Of the extent to which these things have been accomplished at recent conferences it is difficult to judge, but if the danger is avoided of regarding the conference itself as the achievement rather than a preparation for future work, there is ample justification for these national assemblies.

From many points of view, the World Power Conference was the greatest thing of the kind which has ever been organised. It drew a large attendance of men of many nationalities to London, and the various sections into which it was divided reviewed the power problem with a fullness which has never before been attempted. It will probably be admitted, even by those who were responsible for the Conference, that in the end its complete success was partly thwarted by the readiness with which the invitation of the promoters was accepted. An avalanche of papers on every possible aspect of the power question poured in upon the central organisation in a manner which suggested the letting loose, before methods of control had been devised, of unsuspected sources of energy from many quarters. When little more than a year ago the decision to hold the Conference was reached, it was imagined that the papers submitted would have been far fewer in number than those which ultimately occupied a place in the programme, and that copies would be available well in advance of the meeting, so that those participating would be able to discuss the questions raised in the light of fairly complete knowledge of what had been and was being done in the field of power resources. In the circumstances, it is not surprising that there was some failure in this respect, and that faced as they were with a far larger task than had been contemplated, there were certain hitches which gave rise to criticism in some quarters. These things are not referred to in any captious spirit, but because now that a permanent organisation to hold future Power Conferences is to be formed, it is desirable that the small blemishes which to some extent marred the arrangements for the Conference which has just ended should be made impossible. Turning to the work of the congress, as our reports have shown, a very wide field was opened up, and it was made clear that the world's power resources are greater than was imagined, and that solid, if somewhat slow, progress is being made in the elucidation of the technical questions which must receive consideration if the best use is to be made of the assets which Nature has placed at the disposal of man. Perhaps the outstanding features of the Conference were the revelation given of the careful survey of the world's fuel resources which is being carried out, the attempts to utilise these fuels and to harness water power on economic lines, and the wide use which is being made of electric power for industrial and general requirements. It was shown that in many countries super-power zones fed from stations of almost national character are being brought into existence, and that in some instances, notably that of Holland, the electrification of an entire country is being attempted, while in other cases electric power is being exported by a submarine transmission system from one country to another. The account given of the conversion of steam railways to electric traction indicates that the steam railway is, under favourable conditions, being gradually superseded and the trend of policy foreshadowed is that by which current for railway working will be supplied, not from special plants erected for the purpose, but from the general power supply system of the country. Other sections of the Congress gave consideration to the improved and extended use which is being made of power in industry and for domestic use and in agriculture, while questions of education, both on the technical and commercial side, industrial welfare and standardisation also received attention.

The speeches made at the final session of the Congress made it clear that the world's power problem is being approached in a new spirit of co-operation. It only remains for the ambitions outlined during the Wembley meeting to be brought to actual achievement by the steady work which must now be undertaken in all countries. Viewed from this aspect, it is satisfactory to note that a beginning has already been made by the International Electro-Technical Commission, which is holding a meeting in London this week to consider the wider field of work opened to that organisation by the World Power Conference.

Abrasion.

THE engineer looks upon abrasion from two diametrically opposite points of view. He sees it either as a useful agent, as in grinding, or as an anxiety, as in bearings, tires, rails and so forth. But in whichever way he regards it, abrasion is, no doubt, the same, whether it be intentional and violent, or undesired and gradual. In either case we know uncommonly little about its mechanism. It presents certain curious anomalies. For example, some of the new abrasive products of the electric furnace are very much "harder" than the older abrasives, particularly in the old sense of mineralogical "scratch hardness," and yet in some circumstances are not better than the old. It is said that these harder crystals consist of flat plates which do not present good cutting edges to the work, that they are too brittle and readily dis-

integrate, and so forth. Then, in those cases where the engineer is concerned with resistance to wear, another series of anomalies has been encountered. In the former of these cases, research is nearly always directed to the abrasive itself, without consideration of the abraded material, and in the latter the abraded material receives the chief attention. However we measure "hardness," by any of the ordinary methods such as the Brinell or scleroscope tests, the measure affords only a very general idea of the wear-resisting properties of the material; indeed, there are well-known cases of comparatively "soft" metals which resist wear to an amazing extent. Just, however, as in grinding, one is too apt to confine one's attention to the abrasive, so in regard to wear, it is easy to think too much of the metal and too little of the abrading agencies which it is to resist.

It is the latter point which we desire to discuss, since we can only touch upon one aspect of a wide subject. What are, in reality, the abrasive agencies which cause "wear" in different types of working parts? As soon as this question is considered, it becomes obvious that the agencies to be resisted must vary very widely in different cases. Take, for example, a steel shaft running in a well-lubricated white metal bearing. Provided that the lubrication is adequate, and that the bearing pressure is not too high, such a bearing runs without appreciable metal-to-metal contact, and in such circumstances the only abrasive that could affect the shaft or lining must be carried in the oil or find its way into the bearing from outside in some other way. Actually, in such cases where abrasive dust is not too prevalent, wear on bearings is exceedingly small. None the less, the importance of excluding any kind of solid particles from the bearing or the oil needs, perhaps, fuller appreciation than it always receives. If we take, next, the case of a bearing running under less perfect conditions, where there is occasional metal-to-metal contact, the conditions become very different. The small amount of wear due to abrasive particles of outside origin becomes almost negligible in comparison with the internal disintegration. Occasional metal-to-metal contact is always accompanied by some degree of shock; frequently it is the result of temporary excessive pressures on the bearing caused by shock in the mechanism, but at best it results in a temporary very great increase in friction and in local action upon the metal of both shaft and bearing. A small amount of local deformation ensues, and is repeated many times until minute particles of shaft or lining become detached. In favourable, or rather unfavourable, circumstances, these particles may themselves act as abrasives, but here the varying behaviour of different materials makes itself felt quite strongly. White metal linings and phosphor bronzes intentionally contain hard particles intended to resist wear. No doubt they serve this purpose, but the question arises whether, as minute particles become detached during use, these very hard crystal fragments may not, in the end, act as abrasives and accelerate the wear of the bearing. In these two typical cases, the nature of the materials forming the wearing surfaces, and even the kind of matter, if any, which enters the bearing from outside, is to a considerable extent under the control of the engineer, and our point is to suggest that it is well worth while considering how far such control can be properly directed and strengthened so as to secure the exclusion from the bearing of anything likely to cause abrasion. There is, however, a whole great class of cases where control of this kind is practically impossible. Rails and tires cannot be protected from contact with abrasive material, in fact, it is often intentionally introduced, so that in such cases the engineer has to call upon the metallurgist to supply materials that will withstand abrasion—as well as the stresses and shocks of service—to the highest possible degree. To a very considerable extent the harder steels, and still more some of the alloy steels available to-day, have met this demand. The engineer, however, naturally pushes his demands ever further, and the metallurgist does his best to keep pace with them.

It is well to remember that the demand in question is by no means a simple one. In the first place, it is not easy to devise any kind of abrasion test that will give in the laboratory or testing room a reliable indication of how a given material will resist wear in service. Here, as elsewhere, attempts to imitate service conditions and yet to accelerate the test, have failed pretty completely—all the more since service conditions are not entirely understood. Where surfaces are brought into contact under heavy pressures, with shock, and at high speeds, it is not only abrasion, whether by external gritty particles or metal-to-metal, which counts. Anyone who has examined the flowed, work-hardened surfaces of steel rails will readily appreciate this point—that any abrasion test which depends upon purely frictional abrasion cannot indicate the behaviour of steel under such working conditions as those of rails and tires. The use of harder and harder steels naturally suggests itself as a remedy for wear, but with greater hardness we encounter increasing brittleness, and a limit is reached where this defect more than outweighs the gain in wear resistance. Whether or not, in such conditions, a way out can be found is a problem for the metallurgist. Certain alloy steels which harden under wear offer a solution for some purposes, but their use for ordinary rails and tires is not commercially possible, even if it were technically entirely satisfactory. If the metallurgist is to find a solution, it must lie within the economic limits which industrial conditions inevitably impose.

One Hundred Years of British Railways.

No. III.*

PART I.—THE STOCKTON AND DARLINGTON RAILWAY AND ITS PREDECESSORS.

RAILWAYS IN THE PUBLIC SERVICE.

To William Thomas, of Denton, Northumberland, must credit be given for being the first to suggest the universal use of railways or tramways for conveying passenger and goods vehicles. That proposal was made in a paper read on February 11th, 1800, before the monthly meeting of the Literary and Philosophical Society at Newcastle-on-Tyne. The paper not only urged the construction of a railway instead of a canal, but suggested that it might "accommodate the more light and expeditious carriages, such as coaches, postchaises, &c." In this paper the author says:—"Instead of the common wood rail used in collieries, it is proposed to form this way of cast metal plates, applicable to the passage of the common carriage wheels, with a treadway of five inches for each plate, and a ledge or margin three inches high, to prevent the carriage slipping off the road. Each plate to be about five-eighths of an inch thick, and four feet six inches long, to be laid, at the joints, on oak sleepers, and the middle of the plate to be supported by blocks of stone, twelve inches square, in which shall be cut a groove to receive the thickness of the plate, and an oak plug in the centre, to which all the plates are proposed to be nailed. Where the way crosses common roads small concave plates are intended to be fixed, to admit carriages to pass over it without obstruction from the ledge of the plate, as well as to allow their going off, or coming on to, the way without inconvenience. By the adoption of metal plate ways, in preference to the common wood railway, a great part of the friction of the latter will be avoided, the facility of conveyance increased, and the road rendered much more durable. In every half mile of the road, sideways of about sixty or seventy yards long, are proposed to be laid to admit carriages passing each other. These sideways are proposed to be placed in situations where it is found necessary to make a turn or bend in the road, in order to lessen the curve in the sideways."

Just as the name of Telford is linked with the making of roads and Brindley with the construction of canals, so must the names of two men be associated with the development of the railway. These men are William Jessop and Benjamin Outram. The latter was the son-in-law of Dr. James Anderson, and no doubt inspired the article Anderson contributed in November, 1800, to No. 21, Vol. IV., of "Recreations in Agriculture, Natural History, Art and Miscellaneous Literature." Outram, together with William Jessop and Frederick Wright—the last a member of an old Derbyshire family—established, as already related, the Butterley Iron Company in 1790. He was born at Alfreton, and his knowledge of rail and tramways in Derbyshire is reflected in the details given by Dr. Anderson of what had been done in that county and its neighbour, Nottinghamshire.

The article by Dr. Anderson, which, it should again be observed, was no doubt inspired by Outram, was entitled "Cast Iron Railways." The writer of the article regarded the number of horses as an evil to be got rid of. Canals would do, and did, much for transport, "but these, from the nature of the country, must ever be limited in their extent because of the want of water to supply them and other circumstances." What he had to propose "was calculated to facilitate intercourse where canals could not be applicable; and, under proper management, it might perhaps be made in some cases to supersede the use of canals where they were actually practicable." Proceeding, Dr. Anderson observed:—"The reader will easily conceive that I allude to railways, a mode of forwarding weighty articles that has long been in use under certain local peculiarities, but which has not yet been introduced into general practice."

It is worthy of notice that Anderson proposed that the railways should belong to the people. He held that view because of his objection to what he described as the gambling spirit then prevalent in canals and turnpikes. He said:—"To guard against these evils all that is necessary is to prevent these railways from ever becoming private property on any account. To keep them open and patent alike to all who shall choose to employ them as a king's highway, under such regulations as it shall be found necessary to subject them to by law. In short, they should be put upon the same footing in all respects as public roads are at present, only under a distinct set of commissioners who should have the superintendence of everything which concerns this species of roads only. These commissioners should be vested with authority, under an Act of Parliament, to erect turnpikes upon them, to levy certain stipulated tolls and to mortgage the produce of these tolls for the purpose of raising money to be applied in the necessary purchases of land and making the roads. In the Act it should be expressly stipulated that the produce of these tolls should be applied solely to keeping the road in repair, paying the interest on sums borrowed, and clearing off the principal as fast as the collection would admit, and when the whole money borrowed was thus paid off the tolls should be so lowered as only to produce money sufficient to keep the roads in a state of continually good repair. Thus would the expense of transporting goods be annually diminishing and the prosperity of the country be thereby augmenting from day to day."

In view of what railways became and "the prosperity of the country . . . thereby augmenting from day to day," one cannot but admire the vision that inspired the words just quoted. As in the issue for the following February there was another article in which was described how railways should be built—their width, height, gradients, curves, bridges and tunnels—in terms that only an engineer could lay down, the conclusion that Outram inspired these articles becomes almost certain. Outram, it may be added, died suddenly in London on May 22nd, 1805, at the early age of forty-one years. He was the father of General Sir James Outram, one of the heroes of the Indian Mutiny.

In the March, 1802, issue of *A Journal of Natural Philosophy, Chemistry and the Arts*, Vol. I., New Series, appeared an article by Richard Lovell Edgeworth, an Irish engineer and an authority on highways. He said:—"Many years ago I formed the project of laying iron railways for baggage waggons on the great roads of England but having consulted several of my friends, who were eminent mechanics, so many objections were started that I, for some time, despaired of success."

In 1808 a Select Committee sat on the subject of the highways of the kingdom, and in the report that resulted appeared a letter from one Adam Walker to Sir John Sinclair, of the Board of Agriculture. No date is given to the letter. In it the writer says:—"Now, if a plan could be devised of a railway that would not interfere with the profits, management, economy or track of the present turnpike roads, that everything might go on as usual with respect to the tolls, the gates, the carriages, the statute work, &c., and that railways might be brought into general use by such imperceptible gradations and time, as to be what the public so much want, without detriment to any individual—such a railway I humbly conceive to be practicable by introducing, at first only one line of railway, either in the middle of the road or so much on one side of it as to be totally out of the way of the present or usual business of the road. Suppose it at the foot of the footpath and joining the horse-road so that one wheel of the carriage be on the railway and the other on the common road. But it may be said: Why should not both wheels run on iron? I answer, from the prejudices that always impede new devices and the great expense. This is an experiment to initiate the public to the utility of railways, by degrees, on a larger scale and even this would not put gentlemen, farmers, innkeepers, carriers to any new expense in altering their carriages and the common turnpike road would be open to all as usual. Common narrow wheels would be best adapted to the rail, though this single rail, of one foot wide, would admit carriages of all widths, and as they now are, without alteration or addition. This one-rail would not probably cost much more than the expense of repairs for two or three years and would last for some time."

Robert Stevenson, of Edinburgh, now appears on the scene. In reporting, in 1812, to the trustees for the highways and roads within the county of Edinburgh, that celebrated engineer said:—"In some instances, especially within a few miles of Edinburgh, it might be worthy of consideration by the honourable trustees of this county how far cast-iron tracks might not be advantageously laid upon the roads. Some years ago the reporter got two or three yards' length of these iron tracks brought from the Shotts iron works where they have been used for years with much advantage, and, it is believed, with economy. These cart tracks would cost about £2000 per statute mile, including upholding by the ironfounder for one year."

In reporting, in 1818, as to a railway from the coalfields of Midlothian to the city of Edinburgh and port

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of Leith, Stevenson said:—"Waggon-ways, constructed entirely of spare wooden frames or rails, laid in two right lines on wooden sleepers, appear to have been in use at Newcastle as far back as the year 1671. The plan of cast-iron railways seems to have been originally introduced by the great Iron Company at Coalbrookdale in Shropshire, only about the year 1786, as an improvement upon the tram or wooden railway and such are likely to be the benefits resulting from this discovery that we doubt not, as this system develops itself, the name of the person who first conceived the idea will eagerly be sought after and honour done to him as to one of the greatest benefactors of his country."

There must now be noticed a man who, by this time (1817) had been connected with railways for at least ten years, one who by his engineering and legal skill, constant journeying all over the kingdom, personal example, perseverance, financial backing, and, in particular, by the completeness of his schemes, may truly be named "The Father of Railways." The writer refers to William James, whose name, probably, if events were to be recorded in their true chronological order, ought to have been mentioned earlier. James lived amidst the Warwickshire coalfields, and, as agent to many estates, was interested in roads, canals, and railways. This unfortunate man's great work was his advocacy of the Liverpool and Manchester Railway, and it will be in the article under that head that James will mainly be referred to. At this stage it may be noted that in 1799 he was making plans for a railway from Keynsham to Bristol; in 1802 he was in the Leicestershire coalfields and in Lancashire about railways; in 1803 surveying for a canal or railway between Coventry and Warwick; and in 1804 for a railway to join the Ashby Canal. In the very interesting article on "William James and the History of Railways," contributed by Mr. R. Seymour Ramsdale to THE ENGINEER of August 14th, 1908, it was said that James was a warm advocate and shareholder in the Surrey Iron Railway. Though his name was not mentioned in the account—probably the best published—of that line which appeared in the issue of this journal for January 5th, 1900, that is quite likely. That, however, is not the immediate point. The item of interest at the moment is the statement that "when in London he heard of Trevithick and his locomotive and went to Camborne and saw it." His enthusiasm for railways was then greatly increased. Mr. Ramsdale said James "became the heart and soul of the project for connecting the stone quarries at Leckhampton with the Severn at Gloucester." This statement fixes the date of James' activities as about 1807 or 1808, as the Gloucester and Cheltenham Railway was sanctioned on April 28th, 1809—49 Geo. III., c. 23. The Act gave powers for the construction of a line from the basin of the Gloucester and Berkeley Canal to Knapp tollgate in Cheltenham, 9 miles, with a branch 2¾ miles to Leckhampton quarries. A yet greater work was the Stratford and Moreton Railway—sanctioned May 28th, 1821, 2 Geo. IV., c. 63—from the Stratford-on-Avon Canal to Moreton-in-the-Marsh, 16 miles, with a branch of 2¼ miles to Shipston-upon-Stour. It was in the year just named—1821—that James and his son, William Henry, visited West Moor and saw the experiments made with locomotives by George Stephenson and Nicholas Wood. This visit had a noteworthy influence on the future of the Stockton and Darlington Railway. Tomlinson records:—"By July 23rd the directors were in a position to arrive at two important decisions. They adopted the railway in preference to the tramroad and agreed to employ George Stephenson to make a fresh survey of Overton's line (the line as laid out by Overton). To both of these decisions they were probably helped by a remarkable letter from William James to some member of the committee other than Edward Pease. This railway pioneer, who, in the capacity of engineer of the Stratford and Moreton Railway, had visited most of the railroads in the kingdom, described the 'edge rail' (the type introduced by William Jessop) as 'infinitely preferable' to the plate-rail, and eulogised, in no measured terms, the North Country engineers, ranking Stephenson next to Watt in mechanical ability."

James also saw the wagon-way at Bedlington Ironworks on which was tried John Birkinshaw's improved malleable iron rail. This visit called forth the letter, dated June 22nd, 1821, and treasured in the Railway Collection in Newcastle Public Library, in which James said:—"Light has at length shone from the North and I pronounce as my decided opinion that the Malleable Iron Rail Road at Bleddington (Bedlington) Works is by far the best I have seen both in respect of its material and its form."

We must now refer to Thomas Gray, of Nottingham, whose book, published in 1821, was in its fifth edition by 1825. Characteristic of the title pages of that period, it bore the name "Observations on a general iron rail-way, or land steam conveyance, to supersede the necessity for horses in all public vehicles: showing its vast superiority in every respect over all the present pitiful methods of conveyance by turnpike roads, canals and coasting steamers. Containing every species of information relative to rail-roads and loco-motive engines."

The object Gray had in view may be best judged by the following "advertisement" which he inserted in his book:—"The practical economy of steam power is already so fully proved, by its general adoption in our mining districts, in our manufactures and on board our packets, as to afford demonstrative evidence of the numerous but yet unforeseen advantages which might daily be derived from its general application to our inland conveyance.

"By the establishment of a general iron rail-way in a direct line, the distance between the capital and the manufacturing districts and principal cities might be reduced one-quarter and, in many cases, one-third instead of the ridiculously winding course the stage and mail-coaches now daily run.

"As a permanently improving source of revenue to our capitalists this plan would have no parallel; the diurnal returns, at the most moderate toll, upon each vehicle would annually produce many millions; indeed no limits can be assigned to the increase of wealth which this change in our inland conveyance might produce; there is no branch of agriculture, no branch of commerce or of arts but would partake of its endless prosperity. In support of this statement it is merely necessary to remark that one steam-engine, on an improved rail-way, would draw from London to Edinburgh, three stages-coaches—each conveying twice the luggage and number of ordinary stages—in 30 hours which now require 300 horses and at least 50 hours' time for the performance of the journey."

Gray proposed that these railways should be laid along roads devoted solely to them and not on the public highway. The tracks were to be level, with bridges over rivers and viaducts over valleys. There were to be three pairs of rails for each direction of travel to suit the varying speeds. The steam locomotive was to provide the necessary propulsion by means of a cog-wheel. Traversers were to be laid down at intervals to cross vehicles from one line to another and turntables to clear them off the line into the sheds and buildings alongside the railway. Altogether Gray's scheme was a remarkable anticipation—even to the traversers and turntables—of what railways soon became. Of those who refused to support his views he declared, "Eyes have they but they see not; they have ears but hear not." And on the title page of his book he appealed:—

> "No speed with this, can fastest horse compare;
> No weight like this, canal or vessel bear.
> As this will Commerce every day promote
> To this let Sons of Commerce grant their vote."

Gray's appeal fell on deaf ears. He was laughed at for his pains, received neither reward nor thanks for his labour, and eventually died in poverty.

Literature.

The Birth and Development of the American Submarine. By FRANK T. CABLE. Harper and Bros. 12s. 6d. net.

THE main purpose of this volume, so the author tells us, is to place on historical record the achievements of John P. Holland in the sphere of submarine navigation. The subject is one on which Captain Cable is particularly well qualified to write, for he was associated with Holland in the development of the earliest submarines ordered by the United States, the British, and the Japanese Governments, and can look back upon nearly thirty years of practical experience in the design, construction and operation of underwater craft. Holland himself was an Irish schoolmaster, who did not set foot in America until he had passed his thirtieth year. At that time he knew little or nothing of the rudiments of shipbuilding and engineering, yet in spite of this handicap he applied himself with confidence to the solution of a problem which had baffled the skill of highly-trained naval architects. His ignorance of mechanics in those early days is revealed by an incident that happened in 1877, when he completed his first experimental diving boat. He had bargained for the installation of an oil engine in this craft, but on taking her out for a trial "he then discovered that the motor apparatus installed was not operated by oil. It turned out to be an ordinary pair of slide-valve steam engines. Their constructor had run them by compressed air and misled Holland into the belief that oil was used." After various set-backs and failures, Holland succeeded finally in building a boat which was taken over in 1900 by the United States Navy Department, after trials lasting eighteen months. This boat was the prototype of the five "Hollands" which the British Admiralty ordered under the Navy Estimates of 1901, and, therefore, of the modern British submarine. Captain Cable's vivid narrative of his experiences serves to remind us of the dangers and hardships which fell to the lot of those who ventured to sea in these primitive craft. He insists, however, that accidents were more often the result of faulty training or wrong judgment than of mechanical defects. Elsewhere in the book he gives—for the first time, we believe—a full account of the secret building of submarines for Russia and Japan just before and during the Far Eastern War of 1904. None of these boats appears to have been completed in time to take part in the campaign. The political history of the submarine, especially in relation to the Washington Conference, and its future as a naval weapon, are dealt with at some length. While the author's conclusions will not command general acceptance in this country, they are put forward clearly and without bias. "For good or ill," he maintains, "the submarine, with its unlimited potentialities of growth as a war weapon, is fated to become the backbone of navies." We cannot agree that this claim is justified by the lessons of the late war. The submarine is essentially a weapon of surprise. Once its presence is known or even suspected, measures can be taken to render its attack abortive. It is virtually powerless to interefere with a well-screened fleet of battleships or even with a well-guarded convoy of merchantmen. Nor will a mere increase in dimensions add to the offensive power of the submarine. The invention of a single unit method of propulsion, enabling the boat to travel as fast below the water as on the surface, would probably make it much more formidable as an antagonist, but that is a development not yet foreshadowed.

Uber Diesel-elektrische Lokomotiven im Vollbahnbetrieb. Von Dr. Ing. HERBERT BROWN. Zurich: Ernst Waldmann. 1924.

IN this interesting book of some sixty-eight pages Dr Herbert Brown, of Brown, Boveri and Co., of Baden, Switzerland, discusses the theory of the main line Diesel-electric locomotive, its working conditions, and the economies which are likely to be obtained by its use. In the first chapter various systems of power transmission—the direct drive, the geared drive, the hydraulic and compressed air systems, and the electric drive, along with the combined direct and electric systems, and the combined steam and Diesel engine—are contrasted. According to the author, the Diesel-electric solution is to be preferred, as it best fulfils the requirements, and the only drawbacks to its adoption are considerations of weight and the high initial cost of the installation. Chapter II. is devoted to a theoretical investigation of such a locomotive designed for an output of 1500 brake horse-power. The four-cycle high-speed Diesel engine with direct fuel injection is chosen as the best form of prime mover, as, in the opinion of the author, the present experience shows that higher speeds can be employed with four-cycle engines than with those of the two-cycle type. Improvements in the latter type may, however, shortly place the two-cycle engine at least in a position of equality. All the engine auxiliaries are carefully considered, and particular emphasis is placed on the cooling installation and its design. This problem of cooling water is dealt with in a new way, and by means of tables giving sizes of cooling surfaces and velocity of the air and the output of the ventilating fan, particulars are given which will be useful in considering the general problem apart from the special considerations of the Diesel-electric locomotive. In the following chapters the design of the electrical part of the equipment, including the direct-current generators and motors and the voltage and speed regulating devices, is described and illustrated by means of curves and tables. From the data given complete locomotive characteristics are worked out for the 1500 brake horse-power design and outline designs for a 3 C 3 passenger locomotive and a 2 F 2 goods locomotive are given.

The third section of the book is occupied by a discussion of the practical operation of the locomotive and the limitation in loading, starting and running which the Diesel-electric design imposes. Finally a comparison between the proposed locomotive and a steam locomotive of equivalent power is drawn. This section of the book is also illustrated by curves and diagrams.

In the last chapter the author gives a summary of the conclusions derived from his investigations. He finds that the Diesel-electric main line locomotive, while fully meeting all the technical requirements, lacks simplicity, and by reason of its increased weight requires greater length and a larger number of axles than does a steam locomotive of equal output. From the point of view of efficiency the high capital cost of the oil engine-driven locomotive is a disadvantage. The Diesel locomotive will, in the author's opinion, only compete with the steam locomotive where the relative price of coal and oil are favourable to it. There are cases also where shortage of water would create conditions in favour of its adoption. It might also be used with advantage on lines with none or very small gradients and for heavy haulage, where the weight of the locomotive is small in relation to the total train weight. An important factor is, of course, its instant readiness for service, which would do away with the time taken to raise steam in an ordinary locomotive. It is quite possible that the introduction of a high-pressure condensing steam locomotive would reduce the present coal consumption to approximately one half, whereas there is little probability that any serious reduction in the fuel consumed by an oil engine can be made. The most decisive improvement in Diesel locomotive design would be made by the introduction of a high-speed heavy oil engine of light and simple design, which would reduce the weight and size of both the mechanical and electrical equipment. The book is one which we can recommend to all interested in the application of oil engines to railway traction.

The Royal Agricultural Society's Show, Leicester.

No. IV.*

THE most novel feature on the very extensive stand of Blackstone and Co., Limited, of Stamford, was a cold starting crude oil engine. This engine has been designed to meet the requirements for a reliable engine working at moderate pressure on crude or residual oils, without the use of compressed air for the injection of the fuel.

An illustration of this engine is given in Fig. 12, and a sectional view of the fuel injection system in Fig. 13. From the sectional view it will be noticed that the fuel is injected by means of a spring plunger C, composed of two members with a spiral spring E interposed between them. To one end of this plunger the fuel is delivered through the branch H and valves J by a governed pump. The fuel moves the whole of the plunger with its spring bodily outwards, so that the pump does not have to work against pressure. The spring of the plunger is then compressed by a lever B operated from the lay shaft, which acts upon its outer member, the inner member being held by abutting upon the fuel which is retained by the spraying valve F. At the inward end of its travel the lever relieves the pressure of a second or auxiliary spring G, which normally keeps the spraying valve closed against the injection pressure, allowing the pressure of the fuel to open the valve, when the spring of the plunger expands and forces the fuel past the valve into the combustion chamber, where it is ignited by the heat of compression. An advantage claimed for this Blackstone spring injection system is that the fuel is injected under the same pressure and speed, whether the engine be running at its normal revolutions or slowly, as when starting up. Referring to the diagram, it will be observed that until the lug A on the injector lever B strikes the plunger K and relieves the injection valve of the auxiliary spring pressure no oil can enter, but as soon as that point is reached, the spring comes into action and forces the oil into the cylinder. The compression-pressure is 350 lb. per square inch, and the initial pressure at full load 550 lb. per square inch, with a mean effective pressure of 100 lb. per square inch. No preheating of the fuel before entering the injector is necessary unless the engine is required to work upon a fuel which is too viscous to be pumped in its natural state. The smaller sizes of engine that can be pulled round by hand can be started without compression by means of a special device consisting of a removable plug to which is attached a smouldering rag or other igniting device. Engines of this type with single cylinders are constructed in sizes from four brake horse-power to 150 brake horse-power, and above the latter size the engines of this design are made with multi cylinders.

In the drawing the injector spring E is compressed and the lug A on the bent lever B is just about to relieve the pressure of the spring G from the injector valve F, through the medium of levers M N. The movement is only about 0.005in. With a smaller quantity of fuel, as in light loads, the governed pump does not force the injector plunger O so far back, consequently the injection does not last so long. The makers claim that with this spring injection system there is a prolonged combustion period, which gives a flat topped diagram.

Amongst purely agricultural machinery, the firm of T. M. Jarmain, Limited, Oxon, showed a new potato digger, for which it gained one of the Society's three silver medals. Although new to the Show, the machine has, we understand, been thoroughly tested. One of its special features is the design and construction of the tine wheel. This wheel is driven by chain and bevelled gearing from a sprocket attached to one of the road wheels. The tine wheel is arranged at such an angle relative to the ground as to give a peculiar curving action to the tines, so as to disintegrate the soil and expose the potatoes in a diagonal direction with a backward delivery. In front of the tine wheel is a steel share fitted with a detachable point, and as the tines rake across its entire width, the potatoes are lifted and the haulms left on the surface. The main frame is mounted on two axle bearings having a vertical screw adjustment for depth which maintains the correct angle of the share and tines at any required depth. The share is lifted out of work by a hand lever, whilst a separate lever puts the gears in and out of operation.

Another purely agricultural implement of novel design shown was a machine for aerating grass land, made by Ransome, Sims and Jefferies, Limited, Ipswich. This machine is called a grass "Rejuvenator," and is an improvement upon the usual type of harrow. This implement has been designed with the object of severing the turf or matted fibrous roots so as to enable air or manure to have free access to the soil beneath the turf. The machine is provided with a series of cutters which pass through slotted shoes, which latter have upwardly lifted toes to enable them to ride over obstructions and are adjustably connected to provide for a variation of the cut. The cutters are independently spring mounted on bars to enable the machine to follow the inequalities of the ground. A "bursting knife" is mounted at the rear of each cutter to follow in and burst the opening already made, thereby separating and aerating the grass roots and lifting the old dead grass to the surface in a more or less broken condition. Each knife is adjustably mounted to allow for the variation in depth, and the sets of cutters, shoes and knife are arranged in rows one in front of the other. The machine is fitted with a front swivel wheel, and the road wheels have crank axles and are independently adjustable by a hand lever for raising and lowering the cutters in and out of work.

McLaren's Straw Rope Works, of Offerton Hall, Sunderland, showed two machines which created a considerable amount of interest on account of their novelty. One was a machine for making straw rope suitable for foundry work and packing purposes. The machine, which operates equally well with rye, oat, barley or wheat straw and has an average output of 2000 yards per day of eight hours, requires very little power for operation. Two girls were employed at the Show for feeding in the straw. The machine has a drawing and twisting mechanism of very simple construction, and has an attachment which automatically cuts off the rope to pre-arranged lengths. The same firm also exhibited a simple light and efficient thrashing machine in which the elevating and dressing operations are performed by three mechanically-driven fans. The machine only weighs complete about 31 cwt., and has a capacity of 50 bushels of grain per hour. The straw on leaving the drum, which is 6ft. long and fitted with "U" section beaters, is received on a distributor and passed straight and unbroken on to the top shoe which forms the main riddle and, with extensions, the shakers. The bottom shoe is simply an inclined rocking plate which conveys the grain, chaff, &c., to the hopper of the large fan mounted on the main riddle shaft. This fan elevates the grain to a chamber where it is met by the blast of a second fan which carries the chaff, cavings, &c., over the saw-backed riddle of a second dresser. The blast from the second fan is adjusted by a Venetian baffle so that no grain passes over the end of the top riddle. The chaff and cavings fall into a hopper from which a blower, mounted on the same shaft as the second fan, exhausts all chaff, &c., through an overhead tube, and delivers it clear of the machine for bagging. The grain after passing through the saw-backed riddle falls on to a second riddle. Here again the blast from the second fan can be so arranged that all the light grain and "seconds" are eliminated and fall into separate compartments, the heavy grain being carried over the end of the inclined plane to the bagging spout, thus obviating the revolving screen. The machine can be operated and hauled by a "Fordson" tractor.

Goodwin, Barsby and Co., Limited, of Leicester, had an extensive series of exhibits of stone-breaking and road-making machinery, including an open drum tar-macadam plant with a continuous dryer and batch mixer, the plant being of the portable type. The dryer is of the continuous type heated by fires underneath and provided with a continuous flow of dry air by means of fans. The mixer of tar-macadam comprises an open drum to the inside surface of which are attached simple mixing blades. The bottom of the mixing drum is formed by a cast iron pan on which is cast the main driven gear wheel. The entire drum rests upon one central steel or ball bearing so placed as to be as free as possible from dirt. The whole of the mechanism is mounted on road wheels with its own oil engine for operating purposes. The same firm also exhibited a portable automatic stone-breaking plant with a cast steel frame, lower and upper screens, elevators, loading hoppers, feeding platform, &c.

William Cook and Co., Limited, of Sheffield, had an extensive collection of wire ropes and fittings for colliery, agricultural and other purposes. This firm makes a speciality of the manufacture of horse-shoes. In this connection it may be mentioned that owners of horses are anxiously on the look-out for some form of shoe which will enable the horse to obtain a secure footing on the smooth waterproof roads which now generally obtain. Messrs. Cook show two newly patented shoes for this purpose. Clarke's patented shoe is an ordinary single fullered shoe in which the flat portion of the wearing surface is replaced by a serrated portion, the design being such that the depressions fill up with grit and mud, where there is any, which gives an extra amount of grip. The other shoe shown by this firm is called the "Dowling" shoe, in which four rubber studs are inserted on the wearing surface. These studs are of circular form, and as there is a certain amount of space between the lower portion of the stud and the bottom of the hole into which they fit, an air cushion is provided. Messrs. Cook also exhibited an improved drop forged wire-rope socket.

A new machine shown by W. M. Nicholson and Sons, Limited, of Newark-on-Trent, was a front-action side-delivery rake and swather combined. The chief novelty in the machine is the independent head for swath turning. It is mounted behind the side rake bars, and unmasked, when swath turning is to be done, by removing a section of tines from each of the side rake bars, which is very easily and quickly performed by means of the special arrangements provided. The result is to convert the machine

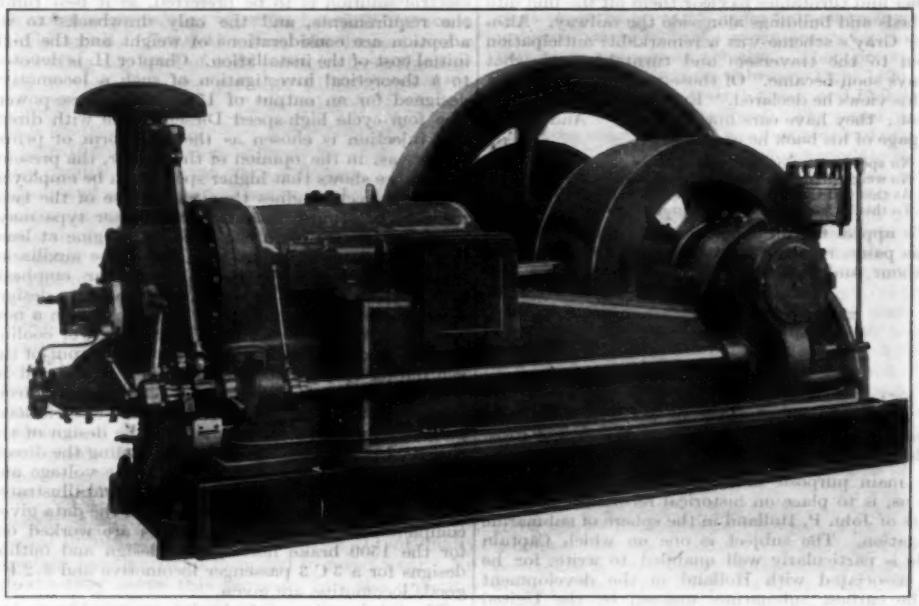


FIG. 12—BLACKSTONE'S COLD-STARTING CRUDE OIL ENGINE

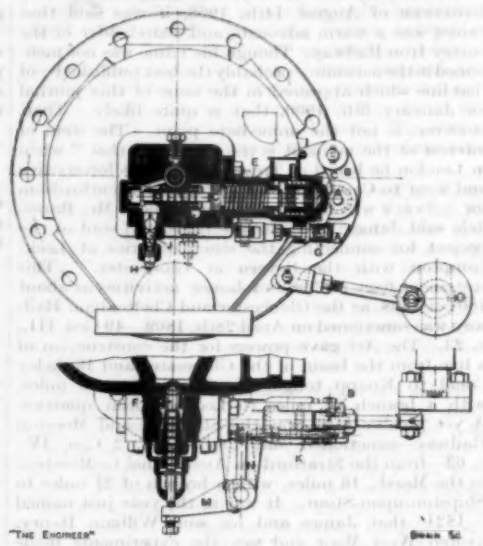


FIG. 13—ARRANGEMENT OF FUEL INJECTION SYSTEM

* No. III. appeared July 11th, 1924.

into a two-head swath turner, which turns the offside swath in behind the near side swath, instead of in front of it as with the usual gap-type combined machines. The independent head can be moved horizontally to suit different widths of swaths, which is a vital adjustment if good turning is to be done. By means of this adjustment the swaths are turned evenly and lie the same distance apart as before turning, an important point when they have to be turned a second time. The sweep and speed of the tines are such as to turn the swath completely over, and to move the whole of it; both swaths are turned alike. The near ends of the side raking bars are bent backwards towards the axle, where they carry the tines that are left on them

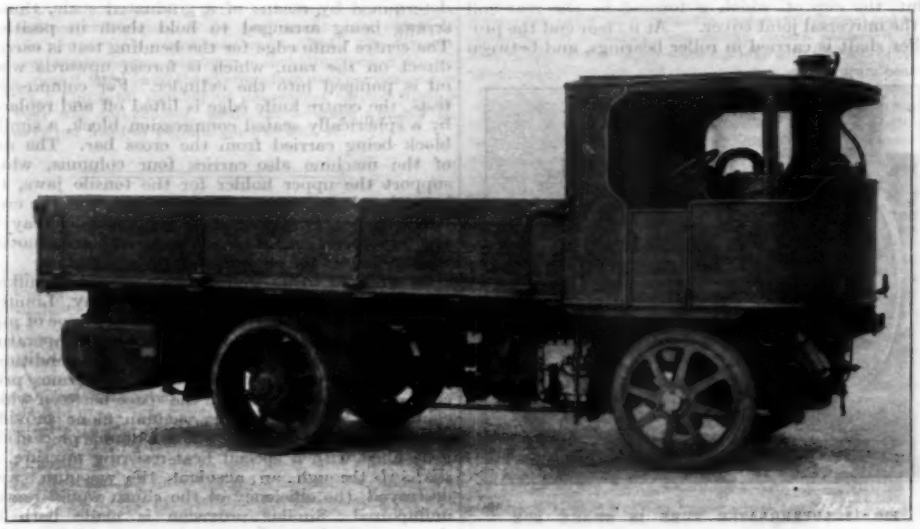


FIG. 14—MANN'S GEAR-DRIVEN STEAM WAGON

when swath turning, and the tines therefore move across their swath at the best angle for swath turning as apart from side raking, and at the same angle as those of the independent head, with the result that even work is done and the swath is properly turned over and not torn to pieces. When raking, the detachable sections of tines are placed in position on the rake bars in front of the independent head, which is then inoperative, and the machine operates as a standard side rake, except that the backward deflection at the near end of the rake bars gives an exceptionally clean delivery, and makes a very neat and well turned windrow. The raking is also very clean at the delivery end, as the off-swath, which is already on the move, passes just in front of the place where the near side tines—which are deflected backwards—are picking up their swath. The near side swath is, therefore, more free to rise and move sideways than if the offside swath were delivered straight on to the top of it, as is the case with straight rake bars. The general construction of the machine is very stiff owing to a special truss bar incorporated in the framework which prevents the forward head of the side rake from sagging. Stiffness in a machine of this type makes for lightness of draught, as any sag causes the distance between the centres of the rake heads to alter and the connecting-rods to bind. The rake and swather heads are hung below the framework, which does not interfere in any way with the motion of the crop, and it has an exceptionally clear passage through the machine. Double cup washers are used throughout to prevent the crop from working in between moving and stationary parts. The gearing is well covered in, and stoppages for clearing the machine are thus reduced to a minimum.

The new steam wagon exhibited by Mann's Patent Steam Cart and Wagon Company, Limited, of Leeds—Fig. 14—has been designed with a view to high speed and load carrying capacity, so that the average travelling speed may be kept high. It is fitted with two gears, and as the engine has two sets of valve cams, each gear can be operated at two points of cut-off and so gives the working equivalent of four speeds with the mechanical parts of two only. As a geared wagon it is built to be fast on top gear and yet with much greater pulling power on low gear than can be obtained by single geared wagon. The engine is horizontal, and is placed across the frame. It has two cylinders, both high-pressure, 5½in. bore and 7in. stroke. By removing a big inspection door the whole engine motion work is fully accessible without getting under the frame, whether the wagon is loaded or not. The engine is fitted with poppet valves and is carried in three-point trunnions so as to be unaffected by twisting or bending of the frame. Roller bearings are fitted throughout the engine and transmission gear and the road wheels run in floating bronze brushes, so that the wagon may be expected to retain its noiseless running and high efficiency throughout its life.

The general transmission is by a propeller shaft to a cased-in back axle of the fully floating type, so that the driving shaft transmits torsion only, and the weight is taken entirely on the outer casing. The whole of the driving mechanism from the engine to the wheels is cased-in and runs in oil, and all gears and shafts are of heat-treated alloy steels of large proportions. In the 6-ton wagon the back axle has a double reduction gear, so that the main wheel, which has the heaviest load on the teeth, is of the spur type, which allows the bevel wheels to enter the train of gears where the load is less.

The vertical boiler is of the stayless pattern with inclined water tubes. The inner flue or fire-box is completely removable. It is pressed to form deep longitudinal ribs which carry the tube plates in tension. The steering gear is of the Ackermann type with ball thrusts, and the spokes of the front wheels are dished to bring the line of thrust beneath the pivot pins to give easy manipulation. The main brake is steam operated direct on to the back wheels, with an automatic, controllable reducing valve. The second brake is on a drum on the propeller shaft, and is very easily adjusted. The principal dimensions of the wagon are as follows:—Body, 15ft. 6in. long by 7ft. wide; overall length and width, 21ft. 3in. by 7ft. 4in.; wheel base, 11ft. 5in.; tire sizes, rear, 160 mm. by 850 mm. fitting; front, 180 mm. by 771 mm. fitting; and the boiler pressure is 250 lb. per square inch.

A new and original use for cement concrete is disclosed in the grinding mill shown by E. H. Bentall and Co., Limited, Maldon—see Fig. 15. In this machine the body is made of concrete, in which are fitted the usual reversible grinding plates, special means being provided to ensure that these plates are true with the spindle, so that an inexperienced person can replace them when worn. The mill is fitted with a riddle feed, by which the amount of corn can be easily regulated to the mill, the straw, &c., being separated from the grain before the latter passes through the grinding plates. The machine is fitted with a hinged sack-lifting device, constructed so that one man can operate the whole mill. The sack of corn to be ground is tilted against the lifter, and the latter is then raised by the mechanism shown into the feeding position. It is then supported by the wrought iron framework, while the corn passes into the hopper as fast as the mill can deal with it. The body of the mill is exceptionally heavy, which enables the mill to operate without the use of foundations and holding down bolts.

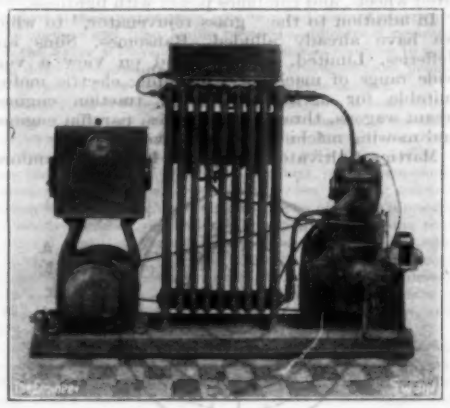


FIG. 16—BOULTON AND PAUL ELECTRIC LIGHTING SET

Electric house-lighting plants and elevators formed the attractive features on the stand of Boulton and Paul, Limited, Ipswich. To meet the demand for a compact plant suitable for small houses and bungalows, this firm has designed a 1-kilowatt set—see Fig. 16—consisting of a generator driven by a belt from the standard "Electrolite" petrol engine and carrier. A novel feature introduced is a cast iron radiator for the cooling water, which is mounted on the bed-plate between the engine and generator, thus saving the space required for a cooling tank and water piping, while retaining the simplicity of the thermo-syphon system. The Boulton elevators for use on deep wells included hand, engine and electrically-driven types. The chief attraction was one of these elevators mounted on a 40ft. tower, and designed to raise about 2500 gallons of water per hour from a large tank at the base.

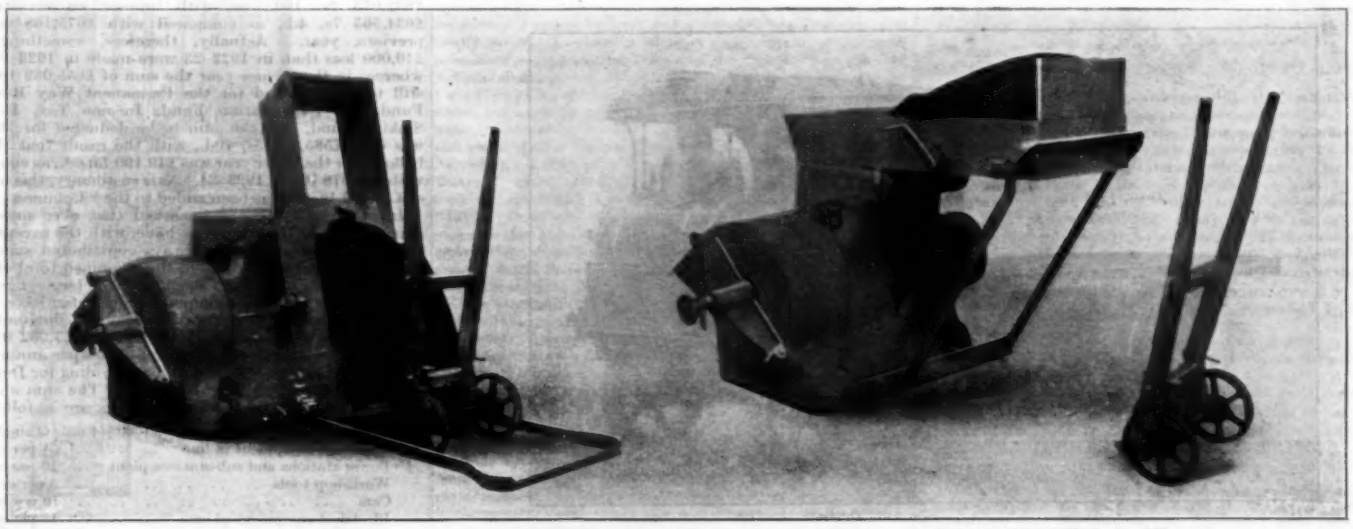


FIG. 15—BENTALL'S GRINDING MILL

The single-sleeve valve petrol engine made by Wallace (Glasgow) Limited, Dennistoun, Glasgow, was shown by the makers applied to electric lighting sets of 3 and 6–8 brake horse-power. The smaller engine is of the air-cooled pattern, and the larger size is water cooled. The Glasgow tractor, propelled by a similar type of engine, of 27 brake horse-power, has been on the market for some time. It has several original features, the most interesting of which is that all three road wheels are driven.

Richard Garrett and Sons, Limited, of Leiston, showed a steam wagon, trailer wagon, a compound steam motor-tractor, two 54in. thrashing machines, and a 48in. clover hulling machine. The steam wagon is designed for 6-ton loads, and is fitted with roller bearings throughout the chassis. The steam motor-tractor is of the compound type, and specially suitable for road haulage and for driving stationary machinery. It is built either with steel or rubber-tired wheels, and combines power with lightness.

In addition to the "grass rejuvenator," to which we have already alluded, Ransomes, Sims and Jefferies, Limited, Ipswich, had on view a very wide range of machinery, including electric motors suitable for agricultural work, traction engines, steam wagons, thrashing machines, paraffin engines, and mowing machines, ploughs, &c.

Martins Cultivator Company, Limited, Stamford,

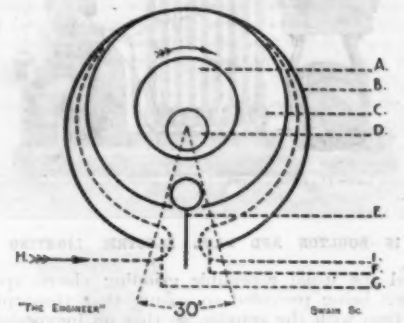


FIG. 17—DIAGRAM OF MARTIN'S PUMP

showed a new and ingenious fire pump of the valve-less pattern. This pump is constructed of phosphor bronze, gun-metal, and stainless steel. It consists of a fixed cylinder B—see diagram Fig. 17—having two elongated ports F G communicating with the inlet and delivery chests, and two circular pistons C mounted on two excentries A at 180 deg., which are keyed to the main driving shaft D, the latter being journalled in the end covers of the cylinder. The two circular pistons, which are smaller in diameter than the bore of the cylinder, make continuous contact at some point with the cylinder walls, and are hinged to slides E working in guides between the inlet and exhaust passages. The pistons are kept separated from one another by a central diaphragm, which divides the cylinder into two compartments, so as to give two suction and two delivery strokes per revolution. By this method of construction the makers claim that the disadvantage of line contact is eliminated, and practically the whole of the displacement volume—the difference between the areas of the cylinder and circular pistons multiplied by their lengths—is utilised. The pump can be operated at comparatively low speeds, and shows remarkable delivery efficiencies. It was shown on a self-contained trailer, and was driven through single reduction gear by means of a four-cylinder vertical petrol engine.

The Yorkshire Patent Steam Wagon Company, Leeds, exhibited an improved steam wagon of 7 tons capacity—Figs. 18 and 19. The new wagon differs from its precursors made by this firm chiefly as regards the transmission gear and the final drive. The boiler is substantially similar to that hitherto adopted, and is disposed across the frame, but superheater tubes are now inserted in the smoke-box at each end—as shown in Fig. 19. The engine is of the vertical, compound balanced type, and develops 50 horse-power, the high-pressure cylinder being 5in. diameter, and the low-pressure cylinder 7½in., both having a stroke of 8in. The engine has a piston valve and Hackworth reversing gear, and a by-pass valve is provided to admit high-pressure steam to the low-pressure cylinder for starting purposes. A gear-box providing three road speeds is spigoted into the engine casing, and gear changing is effected by means of a lever and quadrant at the right-hand of the driver. The propeller shaft is carried in a torque tube, the front end of which has a spherical oil-tight joint, the cup of which is formed by the rear end of the universal joint cover. At its rear end the propeller shaft is carried in roller bearings, and between

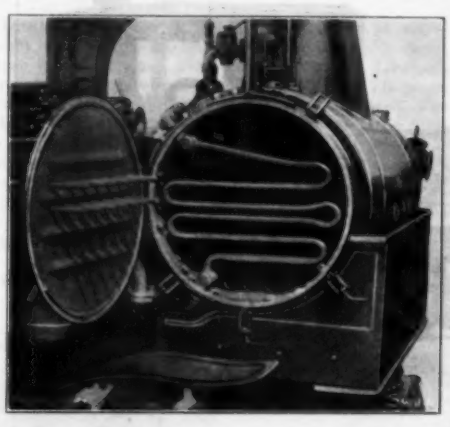


FIG. 19—SUPERHEATER TUBE IN SMOKE-BOX

them is a double ball thrust bearing. The final drive consists of a bevel and spur double-reduction gear and differential gearing. The axle casing is a pot-type steel forging, and the road wheels are mounted on roller bearings at its ends, being driven by axle shafts splined at each end and fitted into the differential and wheel-driving caps respectively. The main spur wheel is bolted in position in the centre of the divided differential cage, and the whole of the gearing can be lifted out after withdrawing the axle shafts. The front wheels are centrally pivoted, and the steering gear is of the Ackerman type.

A special feature of the machinery section was an exhibition of work made by the students of the Loughborough College, Leicestershire. The appliances shown comprised an oil engine with dynamo and switchboard, a 10-ton hydraulic testing machine, a bread cutting and buttering machine, sectional model engines, electrical apparatus and scientific instruments. The experimental oil engine is of the horizontal type and has a single cylinder. It is arranged for starting on petrol, after which it is run on paraffin or other suitable fuel. Thermometer pockets are provided for measuring the heat of the water within the jacket and also on the main bearings for determining the temperature of the oil. The engine is fitted with a water-cooled dynamometer having a spring balance which reads in half pounds to measure the torque. All the cams on the cam shaft are adjustable, and are positively held by being clamped to serrations by lock-nuts. The inlet and exhaust valves are in two parts, so that the total time of lift may be varied. Half compression is obtained by traversing the cams along the shaft by means of a screw. Two cams are also provided for the magneto trip gear so that the advance may be different for full and half compression.

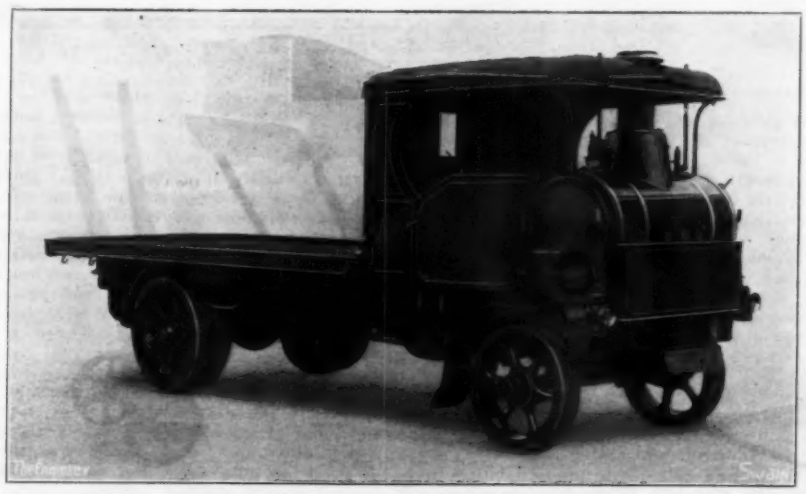


FIG. 18—YORKSHIRE WAGON CO.'S 7 TON STEAM WAGON

The engine is a very creditable production, but the method of attaching the cylinder to the frame is open to criticism, while the main bearing surfaces appeared to be somewhat on the small side.

Another interesting machine shown by the College was that for carrying out hydraulic tests in tension, compression and bending. The hydraulic cylinder is vertical and mounted on a substantial base-plate; a main cross bar, which carries the knife edges for the bending tests, is supported by means of links carried from the cylinder. The knife edges are carried on bases of mild steel, and are of hardened and tempered steel and easily replaceable. The distance apart may be varied, the exact position determined by means of a graduated scale, thumb screws being arranged to hold them in position. The centre knife edge for the bending test is carried direct on the ram, which is forced upwards when oil is pumped into the cylinder. For compression tests, the centre knife edge is lifted off and replaced by a spherically seated compression block, a similar block being carried from the cross bar. The ram of the machine also carries four columns, which support the upper holder for the tensile jaws, the lower jaw being carried from the centre of the cross bar. With this arrangement the machine may be put into operation for tensile tests without removing the appliances for compression or bending.

In addition to its well-known mechanical milking plant, the De Laval Chadburn Company, Limited, Buckingham Gate, S.W. 1, showed a new type of milk churn for maintaining milk at a low temperature irrespective of atmospheric or other conditions. These churns are constructed on the thermos principle, having double jackets the space between which contains a vacuum. This vacuum alone provides an efficient insulating wall, but as a double precaution, it is filled with a special heat-resisting mixture, so that, if through an accident the vacuum were destroyed, the efficiency of the churn would remain unimpaired. Similar provision is made both for the cover and the base, and a valve is provided in a suitable position so that the vacuum can be readily renewed should circumstances require it. A special feature of this churn lies in the fact that in addition to being heavily tinned, the walls are coated with not-corrosive mixture, so that even if the tinning should wear away the milk will not penetrate into the insulating chamber.

Glasgow Corporation Tramways.

THE accounts of the Glasgow Corporation tramways for the year ended May 31st last have recently been published, and they show, as usual, a satisfactory result. The total income for the year was £2,323,245 16s. 6d., as compared with £2,256,477 6s. 10d. for the year 1922–23, and the working expenses, excluding depreciation, were £1,691,170 13s. 8d., as compared with £1,592,684 19s. 8d. The balance on net revenue account was therefore £632,075 2s. 10d., or, with interest on investments, £634,565 7s. 4d., as compared with £675,168 for the previous year. Actually, therefore, something over £40,000 less than in 1922–23 were made in 1923–24, but whereas in the former year the sum of £655,089 10s. had still to be deducted for the Permanent Way Renewals Fund, the Depreciation Fund, Income Tax, Interest, Sinking Fund, &c., the sum to be deducted for 1923–24 was only £585,366 5s. 10d., with the result that the net balance for the latter year was £49,199 1s. 6d., as compared with £20,078 10s. in 1923–24. As is customary, this balance of £49,199 1s. 6d. has been added to the "Common Good."

In passing, it may be remarked that ever since they started in 1894 the tramways have, with the exception of the years 1920 and 1921, always contributed something to the "Common Good," and the combined total of these contributions has now reached the large figure of £1,216,504 3s. 8d. The amounts contributed have varied from £8260 5s. 6d., which was the amount contributed for the eleven months to May 31st, 1895, to £177,552 10s. 1d., the average working out at over £40,500 per annum.

Glasgow has its own method for providing for Depreciation and Permanent Way Renewals. The sum and percentages set aside for various purposes are as follows:—

Permanent way	£1000 per mile of single track
Electrical equipment of line	5½ per cent.
Power stations and sub-stations plant	10 per cent.
Workshop tools	5 per cent.
Cars	10 per cent.
Electrical equipment of cars	15 per cent.
Other rolling stock	20 per cent.
Miscellaneous equipment	6 per cent.
Office furniture and fittings	5 per cent.
Clydebank bridges	5 per cent.

these items all being calculated on the capital expenditure as at May 31st, 1923, which was £5,296,551 15s. 10d. The amount to the credit of the Depreciation and Permanent Way Renewals Fund as at May 31st, 1923, was £782,510 13s. 8d. During the year covered by the report the sum of £173,574 15s. 10d.—the amount expended on renewal of track, &c.—was deducted from the Fund, but as against that the sum of £463,487 17s. 6d. was added to it, so that the amount standing to its credit was, at May 31st last, £1,072,423 15s. 4d.

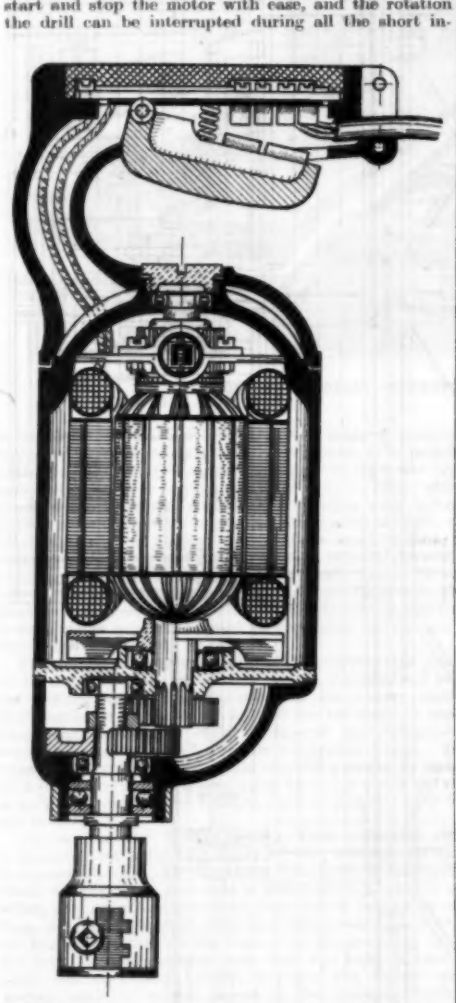
There are, in addition to the Depreciation and Permanent Way Renewals Fund, four other Funds for various purposes, namely, the "General Reserve Fund," the "Third Party Accident Fund," the "Employers' Liability Fund," and the "Fidelity Fund." The amount to the credit of the General Reserve Fund at the end of the

financial year was £15,379 6s. 8d. The Third Party Accident Fund stood at £49,879 9s. 8d., £24,568 3s. having been withdrawn from it during the year, and £40,000 transferred to it. From the Employers' Liability Fund £2724 0s. 9d. were paid out during the year, while £5000 were added to it. Nothing was taken from the Fidelity Fund during the year, but £225 were added to it, so that it stood at £1554 10s. In the five funds, collectively, the Corporation has therefore in reserve on various accounts the very large amount of £1,139,237.

The length of lines working, measured as single track, is 252 miles 6 furlongs 181 yards. The cost of renewal of the track amounted to £109,477 10s. 1d. The actual amount set aside for this purpose, calculated at the rate of £1000 per mile of single track, was £203,319 6s. 4d. As the car mileage was 29,645,098, the sum set aside for renewal of track alone represented just over 1.3d. per car mile. The average total revenue per car mile was 18.808d., while the average working expenses were 12.648d., excluding power works costs and 13.691d. including them. Including the amount expended on permanent way renewals the cost per car mile worked out at 14.578d. The average working expenses per passenger—including power works costs—was 0.943d., and the average fare paid per passenger 1.293d. The total number of passengers carried during the year was 430,226,561, while the average number of journeys per head of population was 302.48.

A Handy Electric Drill.

THE small electrical drill shown in the accompanying illustration has been placed upon the market by the Westminster Tool and Electric Company, of Westool Works, Putney Bridge-road, Putney, S.W. 15. The tool is intended for drilling holes in mild steel up to ¼in. diameter, and it will drill a hole of this size to a depth of 1¼in. in one minute without in any way overheating or overworking the motor. A special feature of the tool is the double-break quick-acting grip switch, which is incorporated in the handle, as shown. The provision of a switch of this form obviously enables the operator to start and stop the motor with ease, and the rotation of the drill can be interrupted during all the short intervals when the drill is not actually working on the metal.



ELECTRIC DRILL WITH GRIP SWITCH

It will be seen that the drill spindle is offset to permit of close side or corner drilling. The motor is designed to work at its full capacity on a direct-current or single-phase circuit, and is ventilated by means of a fan. The ratio of the gearing, which is housed in the lower part of the casing, is 12 to 1. Usually the tool is fitted with a ¼in. Jacobs chuck. The tool case is composed of polished aluminium, and is provided with a recessed thumb rest which makes it comfortable to hold. The total weight of the tool is 7½ lb. Ball bearings are used throughout, and outside lubricators are, therefore, unnecessary.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ORIGIN OF THE THRASHING MACHINE.

SIR,—The following description of one of the early thrashing machines may prove of interest, as it was erected by Rastrick, whose claim to be the inventor of these machines is referred to in a recent issue of THE ENGINEER. The account is from "The Cyclopedia," 1819, by Abraham Rees, D.D., F.R.S., F.L.S., and is contained in Vol. XXXV., under heading "Threshing Machines." "At Brightwell Grove in Oxfordshire, according to the Agricultural Report of that district, there is a thrashing machine belonging to Mr. Lowndes which was constructed by Rastrick, *and in which there is some novelty of contrivance;* it works by means of four horses; the drum wheel in this case is three feet and a half in diameter, makes two hundred and sixty revolutions in a minute, and having sixteen beaters it gives 4160 strokes in that time; there is a rake with four sets of teeth, which takes the straw and delivers it to a second drum-beating cylinder two feet in diameter. This drum is termed the *dresser*, and turning in an opposite direction to the motion of the straw, beats it down, and in its descent strikes it against a circular board, faced with bars shod with iron, through the space of eighteen inches, by which the straw receives several additional strokes, which it is conceived have a great effect in dislodging that corn which has not been completely separated in passing the principal drum. *This is the addition not usual in these machines.* These are wrought four hours at a time, in which eight quarters of wheat are threshed out. Everything is threshed perfectly clean; and the straw is not broken more than by the flail. Twelve quarters of barley are threshed in four hours, and sixteen have been done in that length of time. The horses, in this machine are not attached in the draught, in the manner which resembles pushing, by advancing with the lever before them, but in the common drawing method with the lever behind them, in which way they are supposed by some to do the work much better. This machine was seen to thresh forty-three sheaves in ten minutes. It dresses at the same time, and there is a chaff-cutter, as well as a corn-grinding mill with stones, for farm use attached, and wrought or not at pleasure."

The authorities at the British Museum inform me that the Agricultural Report above mentioned was published in 1809; this shows that Rastrick, who claims to have erected his first machine in 1778, was evidently at the time the Report was issued making machines superior to others then in use.

I am indebted to Mr. H. W. Dickinson, of the Science Museum, for the following extract from "The General View of the Agriculture of the North Riding of Yorkshire," page 81:—"The thrashing mill was introduced into this Riding by E. Cleaver, Esq., of Nunnington, about 1790, for whom Rastrick, of Morpeth, erected one, at an expense of about £100."

London, S.E. 19, July 5th. ARTHUR LEE

BOILER PLANT TESTING.

SIR,—As you have given in your issue of July 11th last a very considerable editorial space to the question of a revised Code for Boiler Plant Testing, especially the history of the subject and the work of the Joint Committee of nine engineering societies, which we are given to understand has been considering this question since September, 1922, I want to know if in fairness you will allow me space in your columns to make some comments on this question, whilst apologising for the length I am asking.

I should like to give for the first time in public some facts relating to the revision of the Institution of Civil Engineers Boiler Test Code. As is well known, I have carried out hundreds of boiler tests since about 1908 and have published the detailed results of about 300 different boiler plants and the average figures for 400. During this long experience, under all kinds of conditions, I gradually built up for myself a practical code, and finally in 1921 I offered a detailed paper to one of the most prominent engineering societies (not the "Civils") on the subject containing the full details of a suggested International Code. I was then told I must not criticise the Institution of Civil Engineers, but must re-write the paper, leaving out entirely their name. Accordingly I did so, and then after much further delay and waste of time the paper was refused, no reason being given. Accordingly I enlarged this paper into my book, "Boiler Plant Testing," which appeared in March, 1922, and incidentally I took the opportunity to say exactly what I liked about the "Civils" Code with the name all complete. Further, I gave a paper on this question of an International Code before the Congress du Chauffage Industriel in Paris, July, 1923, although the present World Power Conference refused to accept a paper from me on the subject. Now, until this book of mine appeared hardly a single word had been said in public against the 1913 "Civils" Code, although, of course, every practical man simply ignored it as hopeless. I state, as a simple matter of elementary fact, that it is due entirely to my publications and original work that the "Civils" Code has now been widely recognised to be such a disgrace that the present Committee was mysteriously appointed in September, 1922.

By what right the thirty-six members of this Joint Committee usurp the authority to speak for British engineering on the intricate subject of boiler plant testing is not clear, like many more things in this history of scientific societies. In the first place, some of the Institutions represented have little standing in the matter, whilst one of the most important, the Institution of Chemical Engineers, has been left out.

I am not acquainted with the names of all the thirty-six members who are on this Committee, but of those I do know, three or four are no more competent to give an opinion of value on boiler plant testing than hundreds of other engineers. As far as I am concerned it will not be much of a boast to say I have had more real practical experience of this subject than all the "Civils" Code Committee of 1913 put together. How any group of engineers could have produced such utter bosh, including the sampling of flue gases over mercury, the pulling down of the main steam pipes to put in antiquated so-called driers, the lower heat value for the coal, the determination of the level of each fire with a huge steel poker cut into inch notches, together with, in the middle of all this mess, the solemn reading of the barometer, presumably to two places of decimals, is beyond comprehension. I defy the sixteen members of this 1913 Committee to carry out an eight-hour test on an average medium-sized boiler plant, according to their own Code, even if they took a month over the job. The point is, are the present Committee any better? There are in Great Britain a limited number of men, probably at the most two or three dozen, who have a profound knowledge and experience of boiler plant testing. They are to be found in the ranks of several water-tube boiler and mechanical stoker firms, consulting engineers, insurance companies and in a limited number of power stations and large industrial plants. These are obviously the men who should be entrusted with drawing up a proper Code.

With regard to the recommendation of this Committee, the mountain has, we understand, now been in labour for nearly two years and the resulting mice include the proposed adoption of the higher calorific value for the fuel and (O help!) the abolition of the expression "boiler horse-power" (!) I may say incidentally that I introduced about 1910 the term "from and at 212 deg. Fah. per 1,000,000 B.Th.U." as an improvement of the stupid phrase "from and at 212 deg. Fah," and the necessity for the use of the higher heat value is described in detail in my book, published months before the Committee was appointed, whilst, of course, every practical man has used this method for years.

I see also the Committee seem to be still footling about with the question of condemning steam meters and water meters, most of which are in practice much more accurate than clumsy weighing. I have never been able to understand why a number of makers of these instruments, who have had years of experience in the business and, for example, received certificates of accuracy from the National Physical Laboratory, should continue to take lying down pompous statements of this character from people who obviously know little or nothing about the subject.

This question of boiler plant testing is only one of many which give rise to the very uneasy feeling that a number of scientific societies in this country are drifting into the control of laboriously competent but dull-witted mediocrities, who have sufficient spare time to attend all committee meetings, paper discussions, dinners, conversaziones, receptions, garden parties, summer meetings and similar functions. This species of person is always the worst enemy of progress and especially of anything that savours of originality and initiative. I see our friends the architects are now trying to "control" their profession and prevent anyone being called an architect who does not conform to dreary routine, oblivious of the fact that some of the greatest architects in the world, such as Inigo Jones, Sir Christopher Wren, and Michael Angelo, were not really "qualified" men at all.

If some of the individuals who help to control our engineering societies have their way, men of genius like, for example, Trevithick, Watt, Smeaton, William Brunton, J. C. Bodmer, and many others would be regarded to-day as rather vulgar and unqualified people, and the rank and file who have to pay many subscriptions would do well to wake up a little.

London, July 14th. DAVID BROWNLIE.

THE MACHINE TOOL INDUSTRY.

SIR,—I have been noting the comment in your issue of May 30th on the address that Mr. Ralph E. Flanders delivered at our last Convention, and also note that you have reprinted it.

I think a careful study of Mr. Flanders' address will not warrant the conclusion that Mr. Flanders thinks that we have reached the end of invention. He is too good an engineer to come to any such conclusion. In fact, he said that the prophecy of the approaching end of the age of invention has always resulted in discomfiture to the prophet. He gave as his conclusion that the "most spectacular inventions of our day are of less human significance than the humbler developments of past generations." This, of course, must be taken in the sense of the relative compared to the extremely primitive age of handicraft.

The great inventions of the industrial revolution in the eighteenth century were far more significant to humanity of that day, than was the perfecting of the automobile within the last twenty-five years, because later the basis of well-being as measured in possession of goods was so much greater that the automobile did not mean as much to humanity in this generation as the steam engine meant to humanity in the days of James Watt.

E. F. DUBBEL.

Cincinnati, Ohio, July 2nd.

CENTENARY OF UNIVERSITY COLLEGE, LONDON.

SIR,—The hundredth anniversary of the foundation of University College, London, will be celebrated in 1926.

Materials—records, reminiscences, pictures, photographs, &c.—are being collected with a view to the production of a History of the College as part of the centenary celebrations. The volume will include a chapter on the School of Engineering.

Members and friends of the College are invited to send such materials as they can contribute to my care for the use of the historian, who will shortly be appointed. All documents will be carefully marked with the owners' names, and will, in due course, be returned, unless the owners desire to present them for the College archives.

Communications and parcels—marked "Centenary"—should be sent to me at the College.

GREGORY FOSTER,
Fellow and Provost.

University College, London, July 15th.

LAUNCHES AND TRIAL TRIPS.

CORINTHIC, steamer; built by Irvine's Shipbuilding and Dry Docks Company, to the order of W. H. Cockerline and Co.; dimensions, 403ft. by 55ft. 0in. by 28ft. 9in.; 8800 tons deadweight. Engines, triple-expansion, 26in., 43in., 72in., pressure 180 lb.; constructed by Richardsons, Westgarth and Co.; trial trip, June 24th, 1924.

GLENBANK, motor vessel; built by Harland and Wolff, Limited, to the order of The Bank Line, Limited (Andrew Weir and Co.); dimensions, 434ft. by 53ft. 9in. by 37ft.; to carry 5200 tons. Engines, six-cylinder Diesel, two sets; constructed by the builders; delivered June 27th, 1924.

MERJERDA, steamer; built by Wm. Gray and Co., Limited, to the order of Frank C. Strick and Co., Limited; dimensions, 381ft. 9in. by 52ft. by 28ft. Engines, triple-expansion, 25in., 40in., 65in., pressure 180 lb.; constructed by Central Marine Engine Works; trial trip, June 28th, 1924.

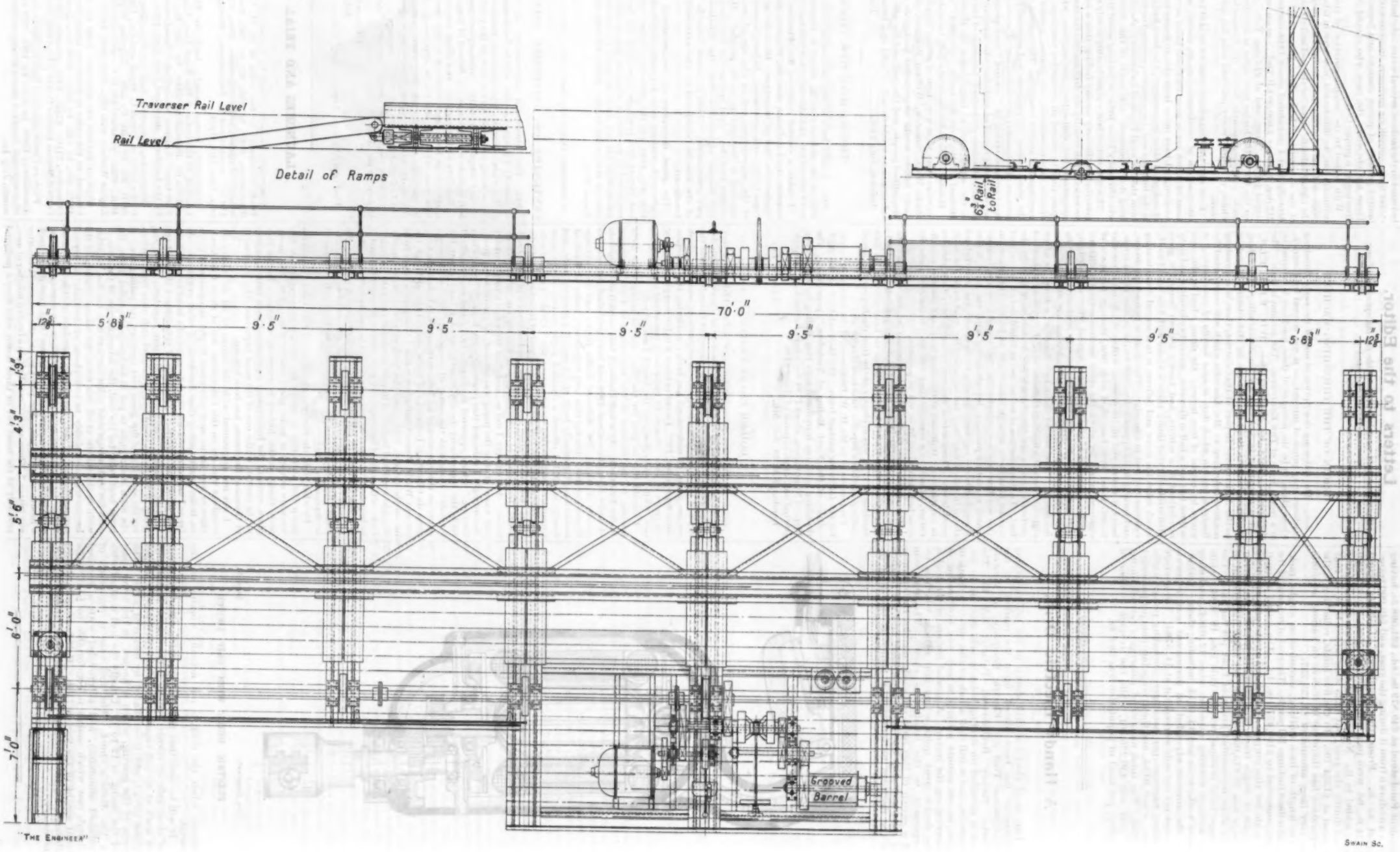
CITY OF SALISBURY, steamer; built by Wm. Gray and Co., Limited, to the order of Ellerman Lines, Limited; dimensions, 431ft. 0in. by 54ft. by 33ft.; 6000 tons gross. Engines, triple-expansion, 24½in., 42½in., 74in., pressure 225 lb.; constructed by Central Marine Engine Works; trial trip, July 1st.

PAPUAN CHIEF, steamer; built by Harland and Wolff, Limited; dimensions, 120ft. by 23ft. by 10ft.; 229 tons gross. Engines, tri-compound inverted direct-acting surface condensing type launch, July 1st.

35-TON ELECTRICALLY-OPERATED "SURFACE" RAILWAY TRAVERSER

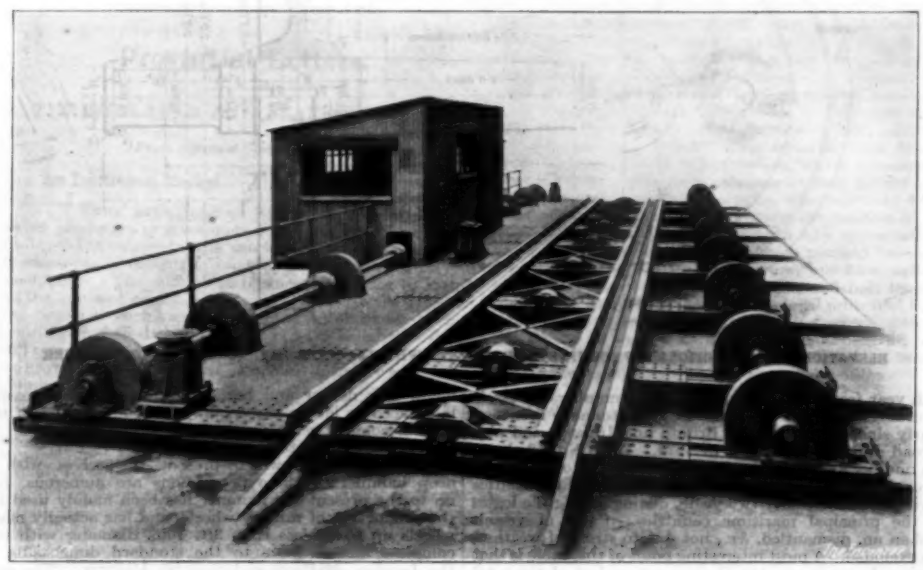
S. H. HEYWOOD AND CO., LIMITED, REDDISH, ENGINEERS

(For description see opposite page)



35-Ton Electric "Surface" Traverser

THE illustrations herewith show an electric surface traverser 70ft. long overall, which has recently been constructed by S. H. Heywood and Co., Limited, Reddish, near Stockport, for carrying the rolling stock of the Bengal-Nagpur Railway Company at their Khargpur workshop. Traversers of the surface type differ from those of the "sunk" type in that they run upon rails at the ground level, and ramps have to be provided to raise the stock from the running to the traverser rails. It is obviously desirable that the height of the latter should be kept within the smallest possible limit, and in order to meet these requirements the structural framework has to be specially designed. In the traverser under notice the actual height from the top of the running rail to the top of the traverser rail is only 6⅞in. When fully loaded the traverser is capable of travelling at a speed of 300ft. per minute, and when light at 400ft. per minute. It moves on 27 cast steel runners, 9 of which, 24in. diameter, are keyed direct on to the driving shaft. The 9 trailing runners are of the same diameter and 9 additional cast steel runners, 10in. diameter, are mounted in the centre of the traverser directly underneath the load. The 18 large runners referred to above are completely enclosed above the level of the traverser framework by cast steel guards. Power is supplied by a 50 horse-power direct-current motor running at 700 revolutions per minute, operating the main driving shaft by spur gearing and a heavy friction clutch. The motor



35-TON ELECTRICALLY-OPERATED "SURFACE" RAILWAY TRAVERSER

is controlled by means of one of the makers' standard tramway type controllers. By this means, it is possible with the clutch fully engaged to start the traverser from rest and operate it continuously by the controller alone, a series starting and regulating resistance with 7 stops being provided for this purpose. On the other hand, the traverser can be started, stopped or manipulated by means of a hand wheel on the friction clutch, the motor running continuously during this period. Tests carried out at the makers' works under full load demonstrated that the traverser could be started and its movements over a wide range of speeds could be regulated by the use of the clutch only.

The ramps are spring-controlled to enable their points to be automatically lifted clear of the running rail after the rolling stock has passed over them. To enable the wagons to be hauled on and off the traverser, a winch consisting essentially of a horizontal spirally-grooved capstan barrel is provided in the machinery house. This capstan is driven from the main travelling motor by means of a friction clutch. When under test this winch exerted a pull of 2 tons on the hauling rope at a speed of 200ft. per minute.

The makers are of the opinion that a friction drive is essential for a hauling winch of this description, since it is possible by slightly engaging the clutch to haul in the slack rapidly when the rope is attached to a wagon, and when the rope becomes taut this clutch begins to slip, thus preventing any sudden and dangerous load coming on the rope owing to the inertia of the standing truck. As soon as the operator sees that the rope is taut he pulls the operating handle, engages the clutch more deeply, and the wagon moves in the desired direction. It will be seen from the engravings that fairleads in the form of revolving pulleys are provided on the traverser to guide the hauling rope.

The machinery is completely enclosed in a sheet metal house provided with large glazed windows and made water-tight to withstand tropical downpours of rain. Within the machinery house is mounted a switch panel of marble containing a double pole quick-make main switch, circuit breaker, double-pole fuses, ammeter, and other electrical fittings. All the electrical wiring consists of lead-covered cable, and all electrical parts were subjected by the makers to a test of 2000 volts alternating for five minutes. The collecting tower is a lattice steel structure, 20ft. high. It is normally mounted at one end of the traverser, but is not shown in the above view. The traverser was erected and wired complete in every detail and tested at full speed in all motions in the makers' works under a test load of 44 tons.

Lloyd's Register of Shipping.

THE new edition of Lloyd's Register Book contains, as usual, very complete particulars of all the sea-going vessels of the world, of 100 tons and upwards, and, in addition, of the steel and iron vessels trading on the Great Lakes of North America. It thus includes a full record of nearly 33,000 steamers, motor ships and sailing vessels. The volumes comprise also many lists of great practical value to the shipping community, such as:—Signal letters assigned to all sea-going vessels; shipbuilders and marine engineers in all countries; telegraphic and postal addresses of firms connected with shipping in all parts of the world; particulars of dry and wet docks, ports, harbours, &c., at home and abroad; particulars of speeds of merchant steamers capable of 12 knots; particulars of deadweight and cubic capacities of cargo steamers and motor vessels; lists of bulk oil carriers; lists of shipowners and managers, with the names and tonnages of their respective vessels, &c.

The section of the book which is perhaps of the greatest interest to the general public is that containing the statistical tables. The contents of the tables will repay careful study, and the following summary of some of the results which are to be obtained by an analysis of these tables and by a comparison with similar tables issued by Lloyd's Register in previous years will be found of interest.

CLASSIFICATION OF VESSELS.

We may, perhaps, before dealing with the other statistical tables, draw attention to the figures shown in Table No. 4 respecting the number and tonnage of vessels classed by Lloyd's Register of Shipping. The new edition of the Register Book contains particulars of 32,956 vessels of 100 tons each and upwards with a total tonnage of 64,023,567 tons and the number and tonnage of existing vessels which are now or have been classed by the Society is 15,679 of 38,505,129 tons. Practically all these vessels were built under the inspection of the surveyors of Lloyd's Register.

Comparison of Gross Tonnage Owned at June, 1923, and June 1924.

	Where owned. Great Britain and Ireland.	Other countries.	Total.
1924—			
Steamers and motor ships	18,954,158	42,559,982	61,514,140
Sailing vessels	151,680	2,357,747	2,509,427
Total	19,105,838	44,917,729	64,023,567
1923—			
Steamers and motor ships	19,115,178	43,220,195	62,335,373
Sailing vessels	166,371	2,664,494	2,830,865
Total	19,281,549	45,884,689	65,166,238

For the first time since these statistical tables have been issued—apart from one or two war years—a decrease is shown in the world tonnage owned as compared with the preceding year. Such decrease is mainly due to the very large amount of tonnage broken up since June, 1923. The table shows that during the last twelve months there has been a decrease in the steam and motor tonnage owned in the world of 821,233 tons, and a decrease in the sailing tonnage of 321,438 tons, making a total world decrease of 1,142,671 tons. Germany and Japan are the only two countries which show an appreciable increase, viz., 363,598 tons and 238,560 tons respectively. Decreases have occurred in most countries, the largest being in the United States sea-going tonnage (1,066,491 tons), in France (239,011 tons), and in Italy (201,539 tons). It should, however, be stated that one-third of the decrease in the United States tonnage is due to the withdrawal from the new Register Book of Government vessels not used for mercantile purposes.

SAILING TONNAGE.

The reduction in sailing tonnage since pre-war times, say, June, 1914, amounts to about 1,470,000 tons gross. The present percentage of sailing vessels to the world's total tonnage is less than 4. Of the world's sailing tonnage 1,186,000 tons—equal to 47½ per cent. of the total tonnage—are now owned in the United States, and the other countries which still have a considerable amount of sailing tonnage are:—France, 208,000 tons; Great Britain and Ireland, 152,000 tons; Italy, 114,000 tons; Norway, 113,000 tons; and Canada, 109,000 tons. If barges which are generally towed and other craft included in the sailing tonnage because not fitted with engines for self-propulsion be excluded, the world tonnage of real sailing vessels only amounts to about 1,710,000 tons, of which 564,000 tons—equal to one-third of the total—are owned in the United States.

TONNAGE OF STEAMERS AND MOTOR SHIPS.

Although there are still about one and a-half million tons of wood and composite steamers in existence at the present time, in view of the comparatively small importance in international trade of such tonnage, it would perhaps be more accurate, for the purpose of comparison between the relative positions of the various merchant marines, if only steel and iron sea-going vessels were taken into account.

Sea-going Steel and Iron Steamers and Motor Ships Owned by the Principal Maritime Countries.

Country.	June, 1914. Tons gross.	June, 1924. Tons gross.	Difference between 1924 and 1914. Tons gross.
Great Britain and Ireland	18,877,000	18,917,000	+ 40,000
British Dominions	1,407,000	2,213,000	+ 806,000
America (United States)	1,837,000	11,823,000	+ 9,986,000
Austria-Hungary	1,032,000	Nil	—
Belgium	341,000	555,000	+ 214,000
Denmark	768,000	974,000	+ 206,000
France	1,918,000	3,193,000	+ 1,275,000
Germany	5,098,000	2,856,000	− 2,242,000
Greece	820,000	751,000	− 69,000
Holland	1,471,000	2,533,000	+ 1,062,000
Italy	1,428,000	2,676,000	+ 1,248,000
Japan	1,642,000	3,655,000	+ 2,013,000
Norway	1,923,000	2,326,000	+ 403,000
Spain	883,000	1,163,000	+ 280,000
Sweden	992,000	1,146,000	+ 154,000
Other countries	2,057,000	2,749,000	+ 692,000
Total abroad	23,637,000	38,613,000	+ 14,976,000
World's total	42,514,000	57,530,000	+ 15,016,000

It will be seen that amongst the principal countries, apart from Germany, Greece is the only one which still shows a reduction in the tonnage now owned as compared with 1914. The sea-going tonnage of the United States has increased by nearly 10 million tons. The other countries in which the largest increases are recorded are:—Japan, 2,013,000 tons; France, 1,275,000 tons; Italy, 1,248,000 tons; and Holland, 1,062,000 tons. Taken together, the Scandinavian countries—Norway, Sweden, and Denmark—show an increase as compared with 1914 of 763,000 tons. In 1914 the United Kingdom owned nearly 44¼ per cent. of the world's sea-going steel and iron steam tonnage; the present percentage is just under 33. The United States now occupy second place with 11,823,000 tons—equal to 20.5 per cent. The other leading countries are:—Japan 3,655,000 tons; France 3,193,000 tons; Germany, 2,856,000 tons; Italy, 2,676,000 tons; Holland, 2,533,000 tons; and Norway, 2,326,000 tons. Notwithstanding recent increases in the tonnage owned in Germany, the above table shows the change which has taken place in the maritime position of that country, where the tonnage now owned is some 2,242,000 tons less than in 1914. Obviously the above figures do not take into consideration the question of the efficiency of the various merchant navies, as in addition to such factors as size, age, type, and speed of the vessels, other circumstances, which do not lend themselves to a statistical analysis, would have to be taken into account.

AGE AND SIZE OF STEAMERS AND MOTOR SHIPS.

A considerable increase has taken place in recent years in the number of sea-going steamers and motor ships of 4000 tons each and above. In 1914 there were 3608 such vessels, and now the number reaches 5916, of which 338 are of 10,000 tons each and upwards, including 33 of 20,000 tons each and upwards. Of the 338 vessels 198 are under the British flag. It may be noted that more than one-half of the total number of vessels in existence consists of those of less than 1000 tons each.

Table No. 13 (a new table added this year) shows that there are now in existence 178 motor ships, each one of 4000 tons and above. Twenty-one of them are of 8000 tons and upwards, their total tonnage amounting to 195,665 tons. From Table No. 3, in which all existing steamers and motor ships are classified according to their size and age, we gather that there are 5059 vessels less than five years old and that their tonnage represents just under 27 per cent. of the total tonnage in existence. Vessels of twenty-five years and over amount to 6848, but their tonnage is only 12.6 per cent. of the total. Of the vessels built prior to 1900 64½ per cent. are of less than 1000 tons each and the average size of the others is 2602 tons, while of the vessels built during the last five years less than 33 per cent. are of less than 1000 tons each and the average of the others reaches 4679 tons. Of the 786 vessels, each of 8000 tons and upwards now in existence, 338 have been built during the last five years. Of the tonnage owned in Great Britain and Ireland 20.1 per cent. is less than five years old. The merchant navies which have the largest proportion of new tonnage (less than five years old), are as follows:—Germany, 52 per cent.; Holland, 36.8 per cent.; Denmark, 33.7 per cent.; France, 32.25 per cent.; Canada, 30.5 per cent.; United States (Sea), 30.4 per cent.; and Norway, 30.3 per cent. The group of vessels which form the largest tonnage is that of between 4000 and 6000 tons each amounting to 17,386,285 tons, equal to 28½ per cent. of the world's total steam and motor tonnage, while the big liners, say, those of 15,000 tons each and upwards, only represent 3 per cent. of such total tonnage.

TYPE OF VESSELS AND OF MACHINERY.

Tables Nos. 6 and 7 show:—(1) The type of machinery used for the propulsion of vessels; and (2) particulars of the oil tankers, of the trawlers and other fishing vessels and of the steamers fitted for burning oil fuel. The first table illustrates the great development which has taken place in the use of steam turbine engines and of internal combustion engines. There are now 1367 steamers of 8,795,584 tons fitted with turbine engines and 1950 vessels (including auxiliary vessels) of 1,973,798 tons fitted with internal combustion engines, as compared with 730,000

tons and 220,000 tons respectively in 1914. Of the 943 tankers (of 1000 tons and upwards) with a total tonnage of 5,193,704 tons, 317 of 1,738,649 tons are registered in Great Britain and Ireland and 408 of 2,451,910 tons are registered in the United States. Of the 3347 steamers of 17,154,072 tons fitted for burning oil fuel, 680 of 4,342,417 tons are registered in Great Britain and Ireland and 1854 of 9,090,860 tons are registered in the United States of America.

The figures in these two tables enable a comparison to be made between the respective need of coal and oil fuel at the present time as compared with 1914.

	1914. % of total gross tonnage.	1924. % of total gross tonnage.
Sailing vessels and sea-going barges	8.06	3.92
Oil, &c., in internal combustion engines	0.45	3.09
Oil fuel for boilers	2.65	26.79
Coal	88.84	66.20
	100.00	100.00

It will thus be seen that only just over 66 per cent. of the tonnage of the merchant marine now depends entirely upon coal, while in 1914 the percentage was nearly 89. The tables show the total tonnage of certain types of vessels, which information would be most useful in estimating the tonnage available for general cargo and passenger purposes. The tonnage of the tankers of 1000 tons gross and upwards amounts to 5,193,704 tons, and in addition there are some 50,000 tons of vessels of less than 1000 tons each. The tonnage of trawlers and other fishing vessels amounts to 790,000 tons. An analysis of the vessels recorded in the Register Book shows that some 324,000 tons represent tugs and salvage vessels, and 314,000 tons steam barges, dredgers and similar craft. Although few paddle vessels are now built, the total tonnage of such vessels in existence still amounts to about 429,000 tons.

TONNAGE OWNED IN THE WORLD AT VARIOUS DATES.

Another table—No. 8—will be found useful for the purpose of ascertaining the development of the merchant navies during the last thirty-five years. It shows for each of the years 1890–1924 the number and the gross tonnage of the steamers and motor ships, and of the sailing vessels owned in the world, distinguishing also the principal maritime countries, and from it some remarkable increases can be observed. In 1890 the gross tonnage of steamers amounted to 13 million tons, and the net tonnage of sailing vessels to over 9 million tons. The steam and motor tonnage has increased by over 48¼ million tons, while the sailing tonnage has decreased by over 7½ million tons gross. Apart from the enormous increase which has taken place in the United States sea-going steam tonnage—12 million tons—and the recent decrease in the German tonnage, both due to the war, the following are the most noticeable changes during this period of thirty-five years:—(*a*) The sail tonnage registered in Great Britain and Ireland and in Norway, which in 1890 amounted to about 2,664,000 tons gross and 1,444,000 tons gross respectively, is now reduced to 152,000 tons and 113,000 tons respectively; and (*b*) nearly 11⅓ million tons of steamers and motor ships have been added to the shipping owned in Great Britain and Ireland, and the steam tonnage of the following countries is now more than six times as large as it was in 1890:—Denmark, Holland, Italy, Japan, Norway, and Sweden. The most remarkable increases have taken place in Japan and Holland, the steam tonnage of which countries now reaches a figure equal respectively to 27¾ times and 11.7 times the total owned in 1890.

The twelve months period prior to the war, during which the greatest increase took place in the merchant navies of the world, was from June, 1912, to June, 1913, when 2,354,000 tons gross were added. During the last three decennial periods the world increases have amounted to 10,052,000 tons gross from 1894 to 1904; 14,106,000 tons from 1904 to 1914; and 14,639,000 tons gross from 1914 to date. The percentage of increase for these periods amounts to practically 40 per cent. for both the first and second periods, but only to 29¾ per cent. for the last ten years.

The following is a summary of the statistical tables issued in the appendix of the 1924 edition of Lloyd's Register Book:—Table No. 1 shows the number, gross tonnage, description and material of the vessels of 100 tons and upwards, belonging to each of the several countries of the world. Table No. 2 illustrates the demand of each country for certain sizes of vessels. The table classifies the steamer and motor ships owned in the world, distinguishing the principal maritime countries, according to certain divisions of gross tonnage. Table No. 3 shows the number and tonnage of steamers and motor ships according to certain divisions of tonnage and of age. Table No. 4 shows the number and tonnage of all vessels in existence which are or were formerly classed with Lloyd's Register. Table No. 5 shows the number of vessels according to certain divisions of tonnage and the total tonnage classed by different classification societies. Table No. 6 shows the type of machinery used for the propulsion of vessels, dividing the vessels according to whether they are steamers with reciprocating engines or turbine engines, or motor ships, or sailing vessels fitted with auxiliary steam or motor power. Table No. 7 shows the number and tonnage of oil tankers, of trawlers and other fishing vessels, and of steamers fitted for burning oil fuel. Table No. 8 shows for each one of the years 1890 to 1924 the number and tonnage of the vessels owned in the world, distinguishing the principal maritime countries. Tables Nos. 9, 10 and 11 are extracted from the annual shipbuilding returns issued by the Society. They show the total number and tonnage of vessels launched by the various countries of the world each year from 1892 onwards, and the number of vessels according to certain divisions of gross tonnage launched yearly since 1909 in Great Britain and Ireland, and also abroad during the years 1918–1923. Table No. 12 shows the number and tonnage of steamers and motor ships lost throughout the world owing to marine and war casualties during the last twenty-two years, distinguishing the losses of the principal maritime countries. Cases of vessels broken up, dismantled, &c., not due to stress of weather, are excluded. A most interesting point of this table is that it gives for each country the percentage lost of the total tonnage owned. Table No. 13 (a new table) shows the number and tonnage of motor ships according to certain divisions of tonnage, distinguishing the principal countries owning such tonnage. Table No. 14 shows the number and gross tonnage of new vessels classed by Lloyd's Register during the calendar year 1923. Notwithstanding the great depression in the shipbuilding industry during that year, the tonnage of these vessels reached the total of 1,070,538 tons.

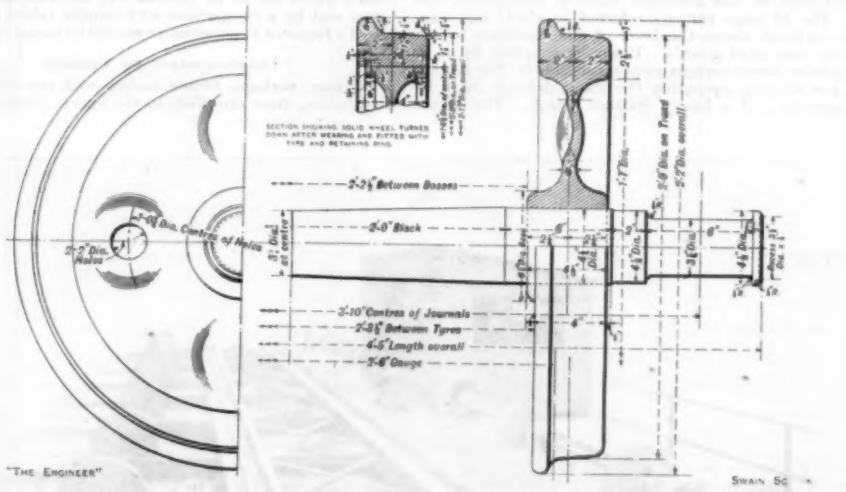
A Remarkable Drop Hammer and its Work.

To the best of our belief the drop hammer which is illustrated on page 76 is the largest in existence. It was designed and made by Brett's Patent Lifter Company, Limited, of Coventry, for Powell-Brett, Limited, of Midland Works, Coventry, by whom it is being used, amongst other things, for the direct stamping of railway carriage wheels. The illustration hardly gives a true impression of its great proportions, but an idea of its capacity may be gathered from the fact that the falling weight weighs no less than 20 tons. The difficulty of providing for the enormous impact when this weight falls from a height of over 10ft. may be readily appreciated, but after one or two misadventures it has been so successfully met that the vibration set up appears to be but little if any more than that produced by a much smaller hammer. The foundation consists of a large mass of concrete, whilst the block itself, mainly underground, is composed of massive forged steel slabs dovetailed together. The lifter is driven by steam derived from the waste heat of the furnaces which heat the blanks. The usual strap connection is employed, and the impact has, therefore, the familiar characteristics of the drop hammer blow.

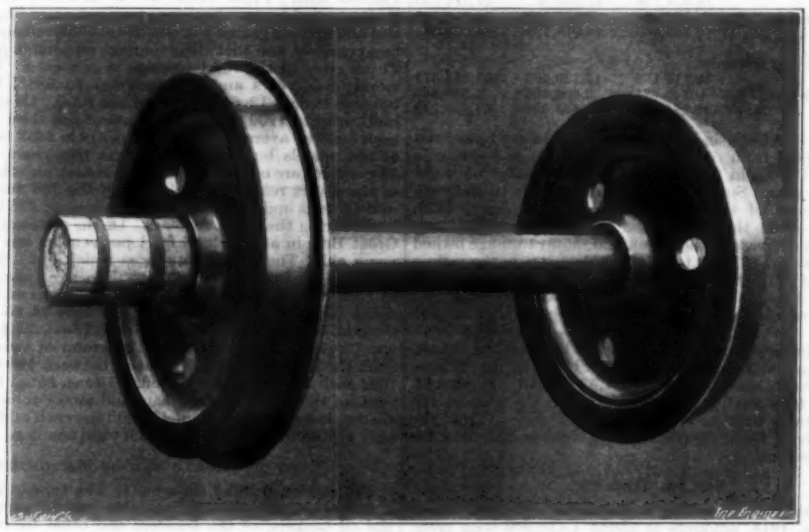
As a matter of interest we have made a rather rough calculation of the force of the blow delivered by this huge drop stamp with its weight of 20 tons falling through 10ft. If we may assume that the penetration by a single blow amounts to ⅛in., then the force exerted—or what is sometimes called "the pressure of the blow"—is no less than 6400 tons. If, as may well happen when the metal gets denser and harder, the depth of impression is reduced to let us say 1/25in., then the pressure of the blow becomes twelve times as great and mounts up to no less than 76,800 tons.

The possibilities which present themselves with a drop hammer of these proportions are numerous, but up to the present the hammer has been mainly used for the production of railway wheels, and has actually made wheels up to no less than 3ft. 10in. diameter with tire complete in one piece to the standard dimensions of the London, Midland and Scottish Railway. The production of smaller wheels such as those for metre gauge railways, which are illustrated herewith, is regarded as childs play! Amongst other interesting work performed on this drop hammer may be mentioned a large number of drop-forged gear blanks for tramways and electric railways. They were turned out at a price that competed with that of cast steel gears.

Drop forging is one of those industries which depend for their success on mass production. The cost of the dies precludes the use of it for single and even for a few parts. To make it worth while, it must be possible to put through large numbers of parts at a time. Now, amongst the larger steel products suitable for stamping, railway wheels fall obviously into this category, for the output of wheels of all sizes and for all kinds and sorts



ELEVATIONS AND SECTIONS OF COMPLETE RAILWAY WHEELS MADE BY 20-TON DROP HAMMER



COMPLETE RAILWAY WHEELS MADE BY 20-TON DROP HAMMER

DROP-FORGED RAILWAY WHEEL CENTRES

of railways runs into hundreds of thousands per year. Hence it is not surprising that Powell-Brett, Limited, have devoted special attention to that product. A new form of disc wheel has been designed, and is now being regularly produced in various sizes. It is known as the Panel Disc wheel, and the characteristics is that additional stiffness is given to the web by stamping in it bulges or panels. It is difficult to describe accurately the form produced, but our reproductions from photographs and a drawing show it fairly clearly.

Absence of a press large enough to take them has so far precluded the accurate testing of these wheels, but Powell-Brett, Limited, have a plant rigged up for the familiar drop test of wheel centres, &c. It has a tup of 25 cwt. A 2ft. panel disc wheel centre was placed under this tup and received seven blows from a height of 10ft. upon the boss; the centre took the coned shape shown in the illustration, but there were no signs of defect anywhere. It may be recalled that the standard test required by consulting engineers for such wheels requires a deflection of the boss from the rim level of $\frac{3}{4}$in. per foot of diameter, or 1$\frac{1}{2}$in. for a 2ft. wheel. The boss in this case was driven down 2$\frac{1}{2}$in., or $\frac{1}{4}$in. more than the standard test demands.

The drawing reproduced on page 86 shows a 2ft. wheel drop-forged with its tire complete, whilst an inset in the drawing shows how the old wheel may be turned down to take a separate tire when it becomes necessary. Mr. Bernard Brett holds the opinion that the work put into the forgings by the enormous blows they receive will render the use of separate tires unnecessary, and that the finish left by the dies is so fine that machining will not be required.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

An Indifferent Market.

VERY little interest appeared to be taken by either producers or consumers on 'Change in Birmingham to-day—Thursday—in the market situation, which was fundamentally much the same as it has been for several weeks now. The volume of business continues to shrink as the summer season advances. This year the effect of the seasonal shrinkage is accentuated, because normal requirements are being postponed in the belief that prices will come down. Structural steel values have fallen slightly, as have those of pig iron. Finished iron prices are unchanged, as are those of galvanised and tinned sheets. Very little business is passing in any branch of the market, the requirements of the Midland works being small, while prospects for the immediate future do not encourage any feeling of optimism. The effect of the building strike is likely to be felt to some extent, chiefly in the department of constructional engineering, while the strike at Messrs. Alfred Hickman's furnaces at Bilston will not tend to improve the position locally.

Staffordshire Steel Works Close Down.

The Springvale Steel Works of Alfred Hickman, Limited, Bilston, the biggest in South Staffordshire, have closed down, throwing between 2000 and 3000 workers out of employment. This is the sequel to the union's demand for increased rates of pay for about 480 of its members at the works. The trouble, which came to a head suddenly on Saturday last, has been brewing for a long time, and negotiations have been in progress for months. The men are members of the Workers' Union, and are engaged on the maintenance plant, and include electricians, stokers, enginemen, &c. As previously reported in THE ENGINEER, they originally asked for an advance of 1s. per shift, and the firm countered this by offering a scale for the lower-paid men up to 10d., this offer being based on a scale then being put forward by the Iron and Steel Trades Confederation, which controls the bulk of the employees of Messrs. Hickman, and in the iron trade generally. The men rejected this offer, and tendered notices, but they were suspended about a month ago on the firm offering to consider the position. Negotiations have since proceeded, and the failure to arrive at any agreement led to the men acting on their notices, and withdrawing their labour at noon on Saturday. This caused the firm to decide to close down completely for the time being, as the withdrawal of labour affected both the blast-furnaces and the steel works. The contention of the firm is that negotiations are at present in progress between the Iron and Steel Trades Confederation and the Employers' Federation for improving the position of the lower-paid men in the industry, and under the circumstances any terms the firm might arrange with the Workers' Union would seriously complicate the position. At the time of writing there was no change in the situation, and what for many years has uninterruptedly appeared a hive of industry was to-day still and quiet.

Pig Iron.

Though pig iron business remains most unsatisfactory, there are producers in the Midlands who consider the prospects of a brisk autumn trade distinctly hopeful. At date, however, the transformation as regards coke and the helplessness of the blast-furnace men in face of the wearing-down tactics of consumers have encouraged the expectation of a more extended breach in selling rates. Hence, there has been a contraction of current business out of proportion to the actual decline in consumptive demand. It is realised in most quarters that these conditions may last till the weather becomes cooler, but the more optimistic speak of some little revival of demand before the autumn demand sets in. Some makers of pig iron are stocking rather heavily, and if the next few weeks do not indicate renewed buying, the furnace owners are likely to cut their losses by reducing output. Following the stoppage of Holcrofts, another company of old standing has now decided to make no more iron at a loss, with the result that several mills have ceased work this week. Very few furnaces are able to dispose of their output. A welcome relief to smelters is the decided fall in the price of furnace coke, now obtainable below £1 per ton. There is much satisfaction that the period of inflation has now passed, and that fuel is plentiful, with a prospect of reasonable rates. In pig iron, forge iron is the dullest department in the Midlands, the South Staffordshire works taking very little material, their mills being mainly occupied in re-rolling steel, a large proportion of which is of Belgian origin. Raw iron values continue to fall, but the extent of the decline is not so great as might be inferred from some special transactions. Odd lots have changed hands under exigency at rates which cannot be accepted as indicating the market level. Makers name very much the same prices as a week ago. In the past month they have become more susceptible to pressure, however, and they are glad to make concessions if by so doing they can do something to relieve swollen stocks. It is obvious that for the time being the demand has almost ceased to exist, and that no moderate reduction of price would reanimate it. Some merchants have bought good lots of pig iron, owing to the fact that the present weakness enables them to get concessions; but this kind of purchase has a strong speculative element, and the venture may prove unfortunate. The approximate position of prices at date so far as there is any business by which it can be tested is North Staffordshire forge iron, £4 5s.; No. 3 foundry, £4 11s.; Northamptonshire forge, £4; foundry, £4 6s. upwards; Derbyshire forge, £4 5s.; foundry, £4 10s. upwards at furnaces.

Finished Iron.

There is no improvement to record in the Staffordshire finished iron trade, and demand continues sluggish. The announcement of the rise of 10s. in Yorkshire bar iron has excited only a very languid interest. Staffordshire and Lancashire Crown bars continue to be offered at the old price of £13, as do marked bars at £15. It is very unlikely that the action of Yorkshire makers will be followed here. The Yorkshire and Lancashire districts are very much better situated than Staffordshire for dealing with export orders, which are showing a little activity. The circumstances of this district afford no ground for increasing the price, whatever may be said about cost of production. Moreover, the position of crude iron seems wholly inconsistent with any appreciation in the finished branches. Staffordshire marked bar houses are not quite so brisk as they were, but have sufficient contracts to keep in operation. Nut and bolt bars continue to be quoted £12, though the local mills find foreign competition keener, following a further reduction of Belgian No. 3 iron to £8 delivered. The demand for all grades of bar iron has lately declined, and no material developments are likely for the next two months.

Sheets.

Galvanised sheets continue to be decidedly the strongest department of the market, makers having good contracts, and as a rule not seeking business for delivery before September. Prices are maintained at £18 5s. per ton for galvanised corrugateds of 24 gauge. A premium is usually demanded for earlier delivery. Thinner gauges of sheets for export are also an improving feature. Makers of lead-coated sheets have reaffirmed their price, £28 per ton to 20 gauge.

Tinned Sheets.

The Tinned Sheet Manufacturers' Association has reaffirmed prices of best charcoal at £58, charcoal £56, and unassorted grades £52 per ton to 20 gauge in each case. During the past quarter prices had been reduced by £2 per ton, and the re-declaration on the reduced basis was anticipated.

Steel.

There is but a feeble demand for steel, and competition, both internal and external, is severe. Production costs are a bulwark against price deterioration, but in the endeavour to find outlets for their products, some manufacturers have this week accepted some low offers. Sections range from £9 15s. to £10. Plates are in slow demand at the former rate of £10 10s. for ship, bridge and tank plates of $\frac{1}{4}$in. and over, and £14 for boiler plates delivered in the district. Staffordshire hoops continue to be quoted £12, but consumers claim to be able to buy below this figure. Small rolled bars sell at prices ranging from £10 to £10 10s. In the semi-finished department complaints are general of the severe cutting of prices. Belgian competitors have made serious inroads in the half-products branch, and native producers are curtailing output. Belgian billets can be imported into the district at something like £6 15s. to £6 17s. 6d. to compete with native billets at £7 12s. 6d. to £7 15s. Cut prices are also being accepted for direct shipment of steel from Antwerp, and Germany is returning to the severe competition in tubes which was a strong feature before the war. It is believed that a settlement of the reparations difficulty would have an immediate effect in developing German competition. Business with that quarter is largely affected by German keenness to obtain British money.

Steel Scrap.

Mild steel scrap continues rather a weak market, with quotations ranging from £4 to £4 2s. 6d. Fewer consignments are coming from Germany, the material for the most part being kept back to meet prospective requirements of the steel furnaces there.

West Bromwich Coal Discovery.

A discovery of great importance to the Black Country has just been made. After four and a-half years' search, the Staffordshire 10-yards thick coal seam has been discovered at the Shrubbery Colliery, Hall End, West Bromwich. When the find is fully developed the close proximity of ample supplies of coal should be of great advantage to the Wednesbury and West Bromwich districts. Drawing commenced this week at the colliery, the plant at which is capable of raising 1000 tons per day.

Unemployment.

The total number of unemployed persons in the Midlands for the last week shows practically no variation, but in Birmingham the number out of work increased from 29,472 to 30,180, while at Coventry there was an increase of 116, the figures rising from 2576 to 2692. Though there was a decrease the previous week, this increase leaves the position practically unchanged. It is significant, however, that to-day in Coventry there are roughly a thousand more unemployed than there were at the end of April. The total number of unemployed in the Midlands is now 128,767, as against 128,736 a week ago. To the total, the Birmingham area contributes 30,180; Bilston, 2793; Coventry, 2692; Cradley Heath, 4642; Dudley, 3952; Northampton, 1371; Nottingham, 8620; Oldbury, 1595; Smethwick, 4119; Stourbridge and Brierley Hill, 3246; Tipton, 2167; Walsall, 5793; West Bromwich, 3068; Wolverhampton, 5914; and Worcester, 1362.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE markets for iron and metal remain dull and depressed, and there is no immediate prospect of a change for the better. The quarterly meeting of the trade in Birmingham, which is looked forward to as a means of ascertaining the general trend of affairs in the industry, passed off without bringing any indication of better feeling, and was rather conspicuous for a lack of vitality and a general contraction in the demand. A good many Manchester iron and steel men go to this quarterly meeting in the hope of gaining information; but one fears that this time they were disappointed. The one hope for Manchester trade just now is in the possible expansion of the cotton industry through the influence of cheaper cotton and a much larger American crop. If this expansion takes place it will react favourably upon engineering in the Lancashire district, and this again will bring more business to the ironfounders and the merchants dealing in pig iron and metals; but, of course, we shall have to wait some months yet before these effects can be felt.

Metals.

The persistent dullness in the copper market is very depressing, and so far as can be seen, there is no immediate chance of a change for the better in this department. The American market has been flat again, and reports of low prices for electrolytic have been received, while the better exchange, of course, tends to make electrolytic cheaper in this country. At one time the price came near to £64 per ton in London, although, of course, merchant prices, on the usual terms of credit, were considerably more than this in Manchester; but refined copper has been cheaper here than since the beginning of the present year. In fact, we have to go back to October, 1923, to find equally low prices. The increase in American stocks of copper seems to be continuing in spite of the effort to reduce the output. It is clear that the American domestic consumption is not yet equal to the absorption of the copper coming upon the market, and the European demand is unsatisfactory. The falling off in the buying of metal by France is accounted for by the political agitation, but one doubts whether this is altogether a satisfactory explanation. Meanwhile the Presidential Election in America will keep business of all kinds quiet until it is known whether Democrats or Republicans are to be in power. A further small concession has been made in some sorts of manufactured metals. For copper locomotive tubes the price was reduced to 1s. 1d. per pound, and for brass locomotive tubes to 11$\frac{1}{2}$d. A reduction of 1s. 4d. per pound was also made on condenser tubes and brazed brass tubes, although the latter, at a higher price than solid copper tubes, still look rather ridiculous. Dealers' buying prices for scrap copper, &c., remain as they were, viz., from £56 to £57 per ton for clean collected copper scrap, £45 to £46 for gun-metal scrap, and £34 to £37 for yellow brass scrap. Their selling prices are, of course, a matter of individual bargaining. Tin has been rather an uncertain market all the week. People are still waiting to see how long the American consumers can hold off the market. It was expected that American buying would have set in long before this; but it is now fairly clear that the depression in the tin-plate trade in America is deeper than was supposed. Without any revival of the American demand one does not see how tin can rise above the present level; rather one would say that the chances are in favour of some reductions, but it is not safe to form any definite opinion. Both lead and spelter have been kept fairly steady for some time, but there seems to be some indications that the prompt price of lead will soon be rather easier.

Pig Iron.

Ironfounders in this district do not seem to be in any hurry to give out orders for pig iron, and the amount of business now being done seems to be smaller than ever. It is not clear whether consumers expect any fall in prices, but at any rate, they are in no fear of a rise and possibly in this view they are right. Any further fall in the Midland foundry iron would probably only come if the Cleveland market gave way, and Cleveland No. 3 pig iron became available here at much lower prices. This is, of course, possible, but so far Cleveland iron in Manchester is still at from 1s. to 2s. per ton above the cost of the Midland irons. Makers of Derbyshire pig iron do not come below 90s. per ton at the furnaces, and this means 97s. 6d. to 98s. delivered here; but there has been more Lincolnshire foundry iron on offer lately, possibly because the Lincolnshire furnaces cannot find a large enough market for the steelmaking qualities of pig iron. There have been sellers of Lincolnshire No. 3 foundry pig at under 97s. 6d. per ton delivered in Manchester. Of course, we know that it was the comparative scarcity of Lincolnshire pig iron which kept the price

above that of Derbyshire; but, as a general rule, the latter has always been preferred for ordinary foundry purposes. Scotch pig iron remains fairly steady at 110s. 6d. to 112s. 6d. per ton in Manchester, but there is very little new business being done in it.

Steel.

The great depression in the steel trade continues, and one is very much puzzled to know what is to come of it. Of course, everyone must know that the productive capacity of British steel works is far too great for existing circumstances; and, moreover, that the costs of production are far too high; but no one can suggest any practicable way of meeting these difficulties. Meanwhile, continental works are turning out steel at from £2 to £2-10s. per ton less cost than is possible here. There is not much continental steel yet being sold in Manchester, but then there is very little being sold whether British or foreign. The nominal prices for delivery in Manchester are £9 7s. to £9 10s. per ton for British joists and angles, and about £7 15s. per ton for foreign sectional steel, £10 2s. 6d. or perhaps £10 for British plates, and £10 to £10 10s. for bar steel. The great difference between bar steel and bar iron is certainly a very awkward feature, and some modification of the finished iron prices seems to be called for.

Scrap.

The demand here for heavy wrought scrap is lessening, and the Lancashire consumer is no longer willing to pay £5 per ton for it. The very low prices for steel scrap certainly suggest to the buyer of wrought iron that the price is too high; but probably the truth is that steel scrap is too low and not that wrought scrap is too high. There is now very little buying of cast scrap here and the market is weak. Some of our dealers still hold out for 90s. per ton for good parcels, but it is fairly certain that the ironfounder can get perfectly satisfactory quality at 85s., or at most at 87s. 6d. per ton.

BARROW-IN-FURNESS.

Hematite.

The position in the hematite pig iron market is not as good as it was. For various reasons it does not seem to develop at all and there is a general lack of life throughout. For one thing, foreign competition is not doing it any good and home consumers are only buying what they are forced to get. It is the high price which is holding up the market. Customers are seeking cheaper iron, whilst ironmakers are faced with such high costs of production that they are in the unfortunate position of securing little or no margin on present prices. But for the fact that the local steel works are taking a large quantity of iron there would be a considerable reduction in the amount produced. Fuel is dear to buy, and this keeps the prices up, and then there is the local rates, which are by no means light, to say nothing of taxes. The outlook is not bright, and at the moment two things are necessary before there is an improvement. One is the appreciation of the franc and another is the reduction in the price of fuel. One fears it will be some time before there is a chance of either of these necessary happenings taking place, and until they do it means a thin time locally. The overseas trade is very small, there is no placing of orders for future deliveries at prices as they are, and customers only order sufficient to keep themselves going, avoiding anything in the way of stocks.

Iron Ore.

The local ore trade is governed by the state of the iron trade, and the conditions which govern the iron markets apply to iron ore, for there is not a large quantity sent out at any time. All mines that have been working are still raising ore, but as soon as there is a reduction in the number of furnaces there will be further restrictions in ore raising. Foreign ore is quiet and there are no heavy imports.

Steel.

The steel trade is suffering from competition, and at the same time there is not a great amount of orders available. One person, who should know, expressed the opinion that there was not a single steel maker making a profit at present prices, and he is not far from the mark. The Barrow rail and merchant mills are working this week, and the Siemens departments are also employed, but for how long it is not possible to say. Fresh orders are needed. A similar state of things exists in Cumberland. The hoop and section mills are better circumstanced.

Engineering.

Vickers Limited, who have developed the department for the construction of large water turbines since the war, have secured an important order for two water turbines from the Government of Ontario, which will each have an output of more than 12,000 horse-power, the height of fall being 72ft. The power is to be used for industrial purposes in and about Fort William and Port Arthur on the north shores of Lake Superior. These turbines will be built at Barrow. The turbine department is very busy at present on several important contracts.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

THE condition of the heavy side of the Sheffield steel trades becomes more and more unsatisfactory every week. This is particularly the case with the department producing open-hearth material of varying grades of quality, which is now in a state of collapse. There has been a falling off of activity at the great works at Templeborough, Parkgate, Stocksbridge and Penistone, and it is doubtful whether, in the whole district, more than a quarter of the furnaces are working. The absence of buying relates to both the home and export markets, and the output is considerably less than was the case at this time last year, although it was not by any means satisfactory then. The position has become so serious that some leading commercial men are apprehensive as to the future, for the continued losses to which firms are subject are alarming. The pig iron trade is also suffering very severely. The railway steel departments continue to be fairly well off for work, but they would be glad of considerably increased orders, which they would have no difficulty in executing. Their trade is chiefly from home companies, the export side of the business being still very small. There is not much being done in the manufacture of private wagons. At the rolling mills and forges, the activity of which is a fair criterion of the general state of the steel trade, things are quieter than they have been at any time during the year. Those in charge state that this is mainly due to a falling off in exports. There has been a serious decline in business with China and Japan, and the only important market which has kept up its purchases at a good level is that of India.

The Lighter Branches.

The position of manufactured steel of various kinds is much more healthy looking. There is a good demand for cold rolled steel strip, and, although the wire trade is less active than it has been, this is thought to be due to temporary causes. The production of motor steel continues on a large scale. The builders of motor vehicles in the country are reported to be very busy—some of them so much so that they cannot keep pace with the orders for new cars—and as a result several Sheffield firms are benefiting from the large demand for steel in many forms, besides tools for use in the engineering shops. There are continuous signs of improvement in the demand for files. The position of this trade is much better than it was, say, eighteen months ago, and compares very favourably with that of pre-war times, but the capacity of the plants has been so much increased that a large additional amount of work is now required to provide full employment. During the week Sheffield has received substantial orders from Russia for both files and saws. Trade with that country, it is hardly necessary to say, is still on a very meagre scale, in comparison with what it formerly was, but there are traders who predict a steady improvement. A moderately satisfactory position is reported by the crucible steel trade, which is doing a regular business with France, and is supplying other continental markets to a less extent.

Orders for Vickers.

Vickers Limited has booked some good orders during the week, and although they are to be carried out principally at Barrow they will no doubt benefit the firm's Sheffield works to some extent. One order is for the supply of heavy gun mountings in connection with the two new 10,000 tons cruisers to be built for the British Admiralty. One of these cruisers will be built at Barrow. The firm is also supplying the smaller gun mountings for the two capital ships now under construction at Birkenhead and on the Tyne. Vickers are now employing nearly 10,000 men at Barrow, and when the work referred to is in full swing, the department concerned will be busier than it has been at any time since the war. The second order which Vickers have booked has been secured through their hydro-electric department, and is for two water turbines for the Government of Ontario. No doubt your Barrow correspondent will refer to this matter.

Cutlery and Plate.

The demand for stainless steel table knives is well maintained, and large quantities are being turned out. A similar condition of things characterises the spoon and fork branches of the electro-plate trade. The call is still chiefly for the cheaper classes of goods, but there is also an improving tone with regard to the better qualities. A very fair amount of trade is being done with various Colonies, and a better footing is being gained in some of the pre-war foreign markets, especially South America. Britannia metal hollow-ware is in good demand, and several firms have more orders than they are able to deal with. There is a scarcity of skilled smiths, which prevents the expansion of the trade.

New Light Railways.

The principal part of the Dearne Valley Light Railway is now constructed, and has been opened to the public this week, thus adding useful tramway facilities to the southern part of Yorkshire. The system, which is about 18 miles long, links up various townships in the valley of the Dearne between Barnsley and Thurnscoe. Its total cost will be about £300,000, which is being borne in varying proportions by the Urban District Councils of Wombwell, Bolton, Wath and Thurnscoe. The estimated population to be served by the new system is 100,000. In connection with the laying of the track, several valuable road improvements have been effected, including the erection of a new bridge across the valley between Wombwell and Brampton Bierlow. The cars are of the single-deck type, with seating capacity for thirty-six passengers. Twenty-five cars have already arrived, and five more are in course of construction. The Yorkshire Electric Power Company, through a transformer sub-station at Wath-on-Dearne, supplies power for the whole route, except the 3-mile stretch inside the Barnsley borough boundary, which section is served from the Barnsley Corporation station. Another light railway which is nearly completed is that from Stretton to Ashover, which is being constructed by the Ashover Light Railway Company, a concern which is closely associated with the Clay Cross Coal and Iron Company. The distance is 4¼ miles, and the railway will be of great use for both passenger and goods traffic. A Ministry of Transport inquiry has been held during the week with regard to the proposed construction of two additional lengths, and the Commissioners intimated that they would report in favour of the granting of an Order. One of these lines will extend to the Butts, where there is a convenient site for a passenger and goods station, close to the Ashover–Matlock road, while the other will serve the Butts Quarry, belonging to the Clay Cross Company, from which it is hoped to get 1000 tons of limestone per week. The company intends to inaugurate a passenger service between Ashover and Stretton and Clay Cross as early as possible, and a supply of passenger carriages is expected within ten or twelve weeks.

Coal Under Sheffield.

As I reported a few weeks ago, the Nunnery Colliery Company, of Sheffield, is the first to make application for power to work minerals under the Mines (Working Facilities and Support) Act, 1923. Its application, which relates to the working of about 600 acres of the Silkstone and Parkgate seams under the city of Sheffield, came before the Railway and Canal Commission last week. It was stated that it was proposed to work under the "half and half" system, which the company has hitherto carried out, and under which more than half of the coal is left in the ground for support. It was also explained that the quantity of coal which the company expected to obtain was 3,000,000 tons, and that this coal could not be worked by any other company, because it would not pay anybody to sink a shaft, having regard to the smallness of the area, and, further, that there was no ground in which a shaft could be sunk. The application was opposed by several important steel firms, on the ground of the danger of subsidence under their works, but a settlement was come to, and the Court announced its intention of sanctioning the working of the coal much on the lines agreed to, although it is taking time to consider one or two points. The main heads of the settlement are that the consideration to be paid by applicants for working the coal shall be £150 per acre for the Silkstone seam and £80 per acre for the Parkgate, irrespective of thickness; that the term during which they may work shall expire in 1941; that they shall work in accordance with the half-and-half system; and that when the workings approach within a certain distance of the objectors' works, notice shall be given.

At Thorne and Askern.

Great satisfaction has been expressed at Thorne, near Doncaster, at the striking of the Kent Thick seam during the sinking operations at the new colliery, as reported last week. Everybody is now looking forward to rapid developments, and to the opening up of a large and prosperous colliery at no distant date. Mr. W. I. Knox, the chief engineer, states that the Kent Thick seam in itself would more or less justify the sinking of the pit if it continues to be as good as it at present appears. The same bed has been struck at Hatfield Main Colliery, where it has been worked to some extent. Presumably, therefore, it extends over the whole field between Hatfield and Thorne. It is a good, clean coal, and should be economically worked. The sinking operations are, however, not stopping at the Kent Thick, but are being pushed on, at the rate of about 35 to 40 yards a month, to the Barnsley bed, which is expected to be struck at a depth of 920 to 940 yards, and of a thickness of 9ft. It is thought that this consummation will be reached next month. With two such seams at its disposal, the Thorne Colliery should develop into a very big undertaking. Considerable progress has already been made with the erection of the surface plant at the colliery, and in due course the usual provisions will be made for housing a big mining population. At Askern Colliery, in the same neighbourhood, a new washing plant has just been erected at a cost of £30,000. It is capable of dealing with 100 tons of coal an hour, and is equipped with a slurry tank with a capacity of 150,000 gallons of water, as well as a reserve bunker for 500 tons of coal.

Airship Building at Howden.

It is announced that the great aerodrome at Howden, which was a centre of much activity during the war, is shortly to be brought into operation again. It is to be used for the construction of an airship of 5,000,000 cubic feet capacity, designed to fly to Egypt and India, the contract for which has been placed by the Air Ministry with the Burney Airship Group. The present proprietor of the aerodrome is Douglas Hollis (Howden), Limited, and the decision to construct the airship there is the result of protracted negotiations between its managing director (Mr. A. K. Kirsop) and the Airship Guarantee Company.

NORTH OF ENGLAND.

(From our own Correspondent.)

Lowest Iron Prices for Two Years.

THE outstanding feature of the course of the Cleveland pig iron trade this week has been a further slump in prices of 1s. 6d. per ton, with the result that the market quotations are now the lowest recorded for two years past. The improvement noted in my last letter proved only a flash in the pan. Once more the market is dull and depressed, and it is difficult to detect any sign of hopefulness in the near future. Export business is as difficult as ever to secure, and the Glasgow holidays have imposed a temporary check upon sales to Scotland. All the heavy foundries are slack, and there are, in fact, no compensating advantages in any direction. For a few weeks at least the iron trade appears to be in for a bad time. The position is such that makers are content if, even at a loss, they can secure orders to avoid closing down. The present production is considerably in excess of demand, and stocks at makers' yards threaten to increase unless sales become heavier or output is curtailed. No. 3 G.M.B. Cleveland pig iron is now quoted at 87s. f.o.t. and 88s. f.o.b. Whether the drop in price will attract buyers remains to be seen, but it is hoped to invade at the reduced figures markets hitherto closed to Cleveland. No. 1 foundry iron is nominally 92s., but it might be shaded. No. 4 foundry is put at 86s., and No. 4 forge at 85s. per ton.

Hematite Pig Iron.

The East Coast hematite pig iron trade is also under the shadow of industrial depression. Makers

cannot secure the renewal of contracts, and the starting of two additional furnaces at Ormesby and Newport has promptly been countered by the prospect of an early stoppage of two hematite furnaces at the Tees Ironworks. This may stiffen the market, but in the meantime prices are still dropping, and mixed numbers are now on offer at 95s. per ton, a drop of 1s. per ton on the week.

Ironmaking Materials.

There is no improvement in the foreign ore trade. Consumers show no disposition to renew contracts, and best Rubio ore at 23s. per ton c.i.f. attracts no attention. Good medium furnace coke is quoted at 27s. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade is without any feature of moment. There is a fair demand for ship plates, but conditions generally are very disappointing. Continental semi-steel is underselling local products, and is being largely used in local works. Prices show a downward trend.

The Coal Trade.

The Northern coal trade is without any special feature of interest, but the position throughout is no worse, and in some individual instances a slight improvement is recorded. So far as the Northumberland trade is concerned, fitters are having difficulty in keeping the pits at work; but, on the whole, the recent average is being fully worked, and occasionally a little additional work is found. Supplies of all descriptions remain abundant, and buyers, either direct or through second-hand holders, have no difficulty in stemming for all available requirements. Best steams are steady, and second and smalls remain at the last quoted values. Special grades of steams are fairly steady, and demand is up to the recent average. Fitters, however, are taking a brighter view of the outlook, and for August supplies nominally ask sixpence per ton higher than current figures. Merchants, of course, are not eager to pay the enhanced prices, and in the absence of transactions actual values are nominal. The Durham position is not very bright, but any alteration is towards a trifle better outlook. In the absence of any active demand holders of all descriptions quote current prices very steadily. They hold that the market has touched bottom, and consequently are not keen to operate on present basis values for any deliveries beyond August. Bunker coals are in ample supply, but prices show some variation, according to actual dates of delivery. The coke trade position shows a decided improvement. Export business for gas coke is more active, and stocks are steadily dwindling. There is, however, little movement in foundry coke.

Cleveland Miners' Wages Reduced.

A reduction of 7 per cent. in the wages of Cleveland miners has been agreed upon between the employers and the men's representatives. In accordance with the sliding scale arrangement, the wages should have fallen by 8.4 per cent., but the mine owners conceded 1.4 per cent. The men's wages now stand at 78 per cent. above the standard, as compared with 85 per cent. in the past three months. The miners' representatives have asked for a special meeting with the employers to consider the proposals concerning working conditions and wages raised at the recent quarterly meeting of the Miners' Association.

SCOTLAND.

(From our own Correspondent.)

Steel and Iron.

PRACTICALLY no change has taken place in the steel and iron markets during the past week, and with the holidays due to commence within a day or two, no developments are likely meantime. While there may have been a little more buying in view of the holidays, there has been nothing like the activity noticeable in normal times. The demand for steel plates has improved a little, and producers are hopeful that the movement will continue after the holidays. Steel sections remain slow. Sheets of the lighter gauges are still a very busy market; in fact, makers have had to refuse some orders. Black and galvanised sheets are wanted for the Continent, as well as for India, South Africa and South America. Australia also is now a buyer. Deliveries of these sheets for the last three months of the year are being negotiated. Bar iron remains without much movement, and re-rolled steel also has only a small turnover at present. Pig iron is weak, neither hematite nor foundry qualities receiving much attention, business being on a small scale all round.

Coal.

Depression has again characterised the coal trade throughout the past week. Many collieries are working short time, while others find difficulty in maintaining even a small measure of activity. Some foreign inquiries have been reported, but there is no expansion in actual turnover. Most buyers are still at variance with the prices asked, and there has been no sign of increased demands usually experienced just before the annual holidays. Shipping returns are fair, and have been augmented by heavy bunker demands, fair quantities of Ayrshire fuels having been sent to coaling stations abroad. Aggregate shipments amounted to 281,762 tons, against 266,874 tons in the preceding week and 319,159 tons in the same week last year. Better business is anticipated in the autumn, and some pits in Lanarkshire, which have been closed for some time, will be re-started, while in other districts new seams are nearing the point of production. New washing plants in Fifeshire are nearly completed. Prices for most descriptions of fuel are unsteady, and the quotations given could in most instances be shaded for a good contract.

Berwick-on-Tweed Coalfield.

About a year and a-half ago the Scremerston Coal Company, Limited, decided definitely to prove the existence of coal seams in the area south of Scremerston Colliery. Drilling was begun 2½ miles south-west of the colliery, but caving difficulties led to an abandonment of the bore at 1332ft. That was in April, 1923. A second bore-hole was begun half a mile further north, and the Scremerston main or Blackhill seam of normal section and excellent quality was found at a depth of 1144ft. Analysis revealed that the coal was rich in volatiles and the ash content lower than any other coal in the district. The Blackhill seam was previously actually proved on the north, north-east, west and south-west, and by this latest boring an area approximating 4000 acres has been proved, in which at least two workable seams—the Scremerston Main and the Cooper Eye seam—may be regarded as existing intact, which without much doubt contain at least 28 million tons of coal. No account has been taken of the large areas south of Ancroft village, where there is a probability that the same coals also exist.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

ON the whole, there is little or no variation in the conditions prevailing in the steam coal trade as compared with a week ago, and it cannot be said that the outlook is any better. The tonnage position has not materially improved, and at practically all the ports there are idle loading berths, and comparatively few steamers are waiting their turn. The demand for coals remains without any appreciable expansion, and it is difficult to get foreign consumers to operate except at prices which are less than those at which business has recently been done. With the exception of the very best Admiralty large coal, the market is very erratic, and it is questionable whether even the best qualities are quite as firm as they were a week or so ago. It is practically certain that the bulk of the shipments which are now being effected are on account of coals held on contract, as it is almost impossible to secure better prices from consumers abroad. Reports have been received that a strike of miners was due to take place on Monday last in the Asturian mines, so that the expectation has been held that there might be a little more inquiry from Spain for coals from this district, but shipments in this direction have lately been rather more active, probably in anticipation of this trouble and, therefore, much depends upon the probable duration of the stoppage whether further extra quantities are likely to be needed from South Wales. So far as the other European countries are concerned, business shows no feature at all and the conditions are very quiet.

M.F.G.B. Conference.

At the concluding day's sittings of the conference of the Miners' Federation of Great Britain held at Swansea last week, resolutions were adopted in favour of a statutory six-hour working day, a five-day week and fourteen days' holiday annually with pay. The question of fixing a uniform age at which boys should be allowed to vote was left to the executive committee. Considerable discussion was given to the position created by the difficulty experienced in some districts of paying the increased rates of wages earned by the miners under the new wage agreement. It was decided to call a special conference on the 22nd inst. to decide what assistance the Federation can render the members thrown out of work through no fault of their own. At a private sitting of the conference consideration was given to a resolution submitted by the Forest of Dean to the effect that steps should be taken to form an alliance with the National Union of Railwaymen, the Transport Workers' Federation and other unions where practicable. It was pointed out that this virtually meant the resuscitation of the triple alliance, although on a slightly larger scale, while the South Wales representatives pointed out that their proposal was for an alliance to be formed with unions connected with the productive industries. The Forest of Dean resolution was withdrawn on the condition that the executive committee would take the matter up and bring it forward at the Trade Union Congress. The executive committee presented a report pointing out that the future policy for the miners on the Minimum Wage Bill should be arrived at jointly between the members of Parliament and the executive committee on the understanding that any decision come to should be referred to the coalfields for ratification.

Trouble Threatened at Ebbw Vale.

The report is current that labour troubles are again threatened at Ebbw Vale arising out of the non-unionist question. Members of the allied skilled trades are on strike because two workmen have declined to join the Amalgamated Engineering Union, and in consequence of this stoppage it is stated that the Ebbw Vale Company intends closing down this week its works, with the exception of the sheet mills and collieries, for an indefinite period. This means that over 2000 men will be thrown out of employment. It is understood that the company proposes to damp down the furnaces, but that they will not be raked out.

Third Shift Working and Dock Delays.

The announcement was made at a meeting of the Cardiff Chamber of Commerce on Monday that the question of the third shift at the various ports in this Channel was to be discussed on Thursday of this week at an informal meeting of representatives of the Great Western Railway Company, the traders and the tippers and trimmers. A report received from the Dock Delays Investigation Committee stated that one of the causes of the delays in coal shipping was that those responsible for loading vessels frequently put vessels into berth without having made complete arrangements to ensure continuous shipmen', with the result that serious delays frequently took place while the arrival of coal at the shipping appliances was being awaited. These delays naturally militated against the efficiency and good reputation of the South Wales ports. The president—Mr. C. L. Clay—drew attention to Mr. Lloyd George's proposed Coal Mines Bill, and strongly protested against the fate of the coal trade being decided not on economical lines but according to the swing of the political pendulum. He considered it was high time to protest not against any one political party but against any party which for political purposes tampered with the freedom of trade, and especially the most vital trade in the country.

Reduced Shipping Values.

As is well known, the values of tonnage have fallen very considerably in the past year or two, and this fact is illustrated by the proposed action of the managers of two Cardiff undertakings under the control of Sir W. R. Smith and Sons. The two companies are the St. Just Steamship Company and the Leeds Shipping Company. To bring the capital more into line with actual values it is proposed to reduce the £1 shares in the former company to the denomination of 10s. shares, and in the case of the latter to reduce the shares from £1 to 7s. 6d. each. The St. Just Steamship Company has an issued capital of 2,064,000 shares of £1 each and the Leeds Shipping Company's capital is £400,000 in shares of £1 each.

Current Business.

The tone of the steam coal market has been very quiet in all directions, though best Admiralty large coals are relatively steadier than others. Best Admiralty large is about 28s. to 28s. 6d., with second qualities round about 27s. to 27s. 6d. Smalls of all descriptions are plentiful and are slow to move off, and patent fuel and coke show no change. Anthracite coals are in fair demand, particularly the superior grades of sized coals.

EDUCATIONAL INTELLIGENCE.

THE following awards have been made at University College, London:—Faculty of Engineering: Jews' Commemoration Scholarship, for the student of one year's standing, not being medical, who is most distinguished by general proficiency and good conduct, J. L. Derwas; Goldsmid Scholarship, third year, T. A. L. Paton; second year, C. Murray; L. F. Vernon-Harcourt Prize, civil and municipal engineering, P. Hall; Archibald P. Head Medal and Prize, mechanical engineering, T. T. Lambe. Diplomas in Engineering have been obtained by the following:—Civil and Municipal: H. Barnard, P. Hall (with distinction), Janet M. Harris, H. Kaufman, A. A. L. Lane, D. M. Mactavish, C. H. Pridham, and R. R. H. Rains. Mechanical: T. T. Lambe (with distinction), J. W. Martin, T. R. T. Middleton, and H. E. Venables; and Electrical: B. Behrman, D. H. W. Channon, D. J. Comino (with distinction), A. H. Couzens, H. M. Fricke, R. Hynes, F. J. Jenvey, W. D. W. Ross, and J. R. Tugwood.

CONTRACTS.

VICKERS LIMITED, hydro-electric department, has received an order for two large water turbines from the Government of Ontario, through its Hydro-electric Power Commission. Each turbine will have an output of more than 12,000 horse-power, the height of fall being 72ft.

IT is announced that the Bombay Port Trust has accepted the tender of Sir W. G. Armstrong, Whitworth and Co., Limited, for a steel floating caisson for the entrance to the Merewether dry dock, Bombay. The caisson will be constructed at the firm's Walker shipyard, Newcastle-on-Tyne.

WAYGOOD-OTIS CLUB: ANNUAL SPORTS.—The annual sports of the Waygood-Otis Club were held at Whitefoot-lane, Catford, on Saturday, June 28th. The cup, presented by Mr. H. C. Walker for the highest aggregate of points, was again won by S. Piper, who also won the "W. R. Green" Challenge Trophy, which he had won last year. There was a full programme, and a large attendance, and though no very startling times were made, the event was in every way a success. The prizes were distributed by MRS. D. W. R. Green.

BRITISH STANDARD SPECIFICATIONS.—The British Engineering Standards Association has recently issued a specification covering two grades of silver solder (Publication No. 206, 1924), the silver content in grade A being between 60 and 62 per cent. and in grade B between 42 and 44 per cent. Specifications for various grades of tin-lead solders and for brazing solders are in course of preparation. Two specifications for special brasses, one for ingots for castings (Publication No. 207, 1924) and the other for actual castings (Publication No. 208, 1924) have also been published. These two specifications cover the same five grades of materials, which are classified according to their minimum tensile strength; these range from 28 to 45 tons per square inch. The copper content of each class is specified, a maximum total percentage only being given for metals other than copper and zinc which are tin, iron, manganese, aluminium and nickel. Copies of the specifications may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, Westminster, S.W. 1, price 1s. 2d. each post free.

SUBSIDY TYPE LIGHT LORRIES.—A specification for the War Department subsidy type light lorry, which was published a few days ago, defines the type of vehicle the War Office is enrolling under the subsidy scheme; and it is officially stated that it is the intention of the department to utilise this specification not only in respect of vehicles subsidised, but in respect of vehicles purchased by the War Office. The subsidy type light lorry will now differ very little from the light char-à-banc and 30-cwt. and 2-ton lorries of the latest British-made types in commercial use. Although the specification describes a pneumatic-tired vehicle with 38 or 34 by 7 giant tires, the subsidy may be granted in connection with vehicles which normally operate on solid or twin pneumatic tires but are so designed that a quick change-over can be effected when desired to the War Department standard pneumatic tires. Provision is made for electric lighting, a speedometer and a power-driven tire pump, but these items need not necessarily be fitted to the vehicles accepted for subsidy. Copies of the specification, and particulars of manufacturers building vehicles which comply with it, can be obtained from the Chief Inspector of Subsidised Transport, Caxton House, Tothill-street, Westminster, S.W. 1.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/–
(1) Spanish	23/–
(1) N. African	23/–
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 0 0	—
No. 1 Foundry	5 1 3	—
No. 3 Foundry	4 16 3	—
N.E. COAST—		
Hematite Mixed Nos.	4 16 0	4 16 0
No. 1	4 16 6	4 16 6
Cleveland—		
No. 1	4 12 0	4 12 0
Silicious Iron	4 12 0	4 12 0
No. 3 G.M.B.	4 7 0	4 7 0
No. 4 Foundry	4 6 0	4 6 0
No. 4 Forge	4 5 0	4 5 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 5 0	—
„ „ Foundry	4 11 0	—
(3) Northampton—		
Foundry No. 3	4 6 0	—
„ Forge	4 0 0	—
(3) Derbyshire—		
No. 3 Foundry	4 10 0 to 4 11 0	
Forge	4 5 0 to 4 7 6	
(3) Lincolnshire—		
No. 3 Foundry	4 12 0	—
No. 4 Forge	4 13 0	—
Basic	4 5 0 to 4 10 0	
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 12 0 (a) / 5 15 0 (b)	— / —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E COAST—		
Common Bars	12 10 0	—
LANCS —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 0 0 to 10 5 0	
Intermediate Basic	9 10 0 to 10 0 0	
Soft Basic	8 5 0 to 8 10 0	
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 0 0 to 10 10 0	
Billets and Sheet-bars	7 12 6 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 15 0 to 10 0 0	
Joists	9 15 0 to 10 0 0	
Tees	10 15 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	22/7½ to 22/10½
Block Tin (cash)	226 5 0
„ (three months)	227 15 0
Copper (cash)	60 17 6
„ (three months)	61 0 0
Spanish Lead (cash)	32 15 0
„ (three months)	30 5 0
Spelter (cash)	32 2 6
„ (three months)	31 15 0
MANCHESTER—	
Copper, Best Selected Ingots	67 10 0
„ Electrolytic	65 0 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	35 0 0
„ Foreign	34 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
„ 6 p.c. to 8 p.c. „	£23 10 0	8/–
„ 8 p.c. to 10 p.c. „	£23 0 0	8/–
„ Specially Refined		
„ Max. 2 p.c. carbon	£42 10 0	16/–
„ „ 1 p.c. „	£51 0 0	17/6
„ „ 0.75 p.c. carbon	£68 0 0	20/–
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
„ „ 75 p.c.	£18 10 0 scale 6/– per unit	
„ Vanadium	19/3 per lb.	
„ Molybdenum	8/3 per lb.	
„ Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£120 to £130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/3
„ „ Ell	18/6
„ „ Splint	20/– to 23/–
„ „ Trebles	19/–
„ „ Doubles	18/6
„ „ Singles	17/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/3
„ „ Splint	20/–
„ „ Trebles	19/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	15/3 to 19/9
Screened Navigation	25/6
Trebles	21/–
Doubles	19/–
Singles	17/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	17/3
Secondary Steam	16/3
Trebles	19/9
Doubles	18/9
Singles	17/3

ENGLAND.

(3) N.W. COAST—	
Steams	30/–
Household	45/– to 58/4
Coke	33/6
NORTHUMBERLAND—	
Best Steams	19/6 to 20/–
Second Steams	18/6 to 19/–
Steam Smalls	10/6 to 11/6
Unscreened	16/– to 17/–
Household	27/–
DURHAM—	
Best Gas	21/6 to 23/–
Second	19/6 to 20/6
Household	27/–
Foundry Coke	26/6 to 27/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/– to 35/– —
Barnsley Best Silkstone	28/– to 29/– —
Derbyshire Best Brights	28/– to 30/– —
„ „ House	25/– to 27/– —
„ „ Large Nuts	24/– to 25/– —
„ „ Small „	18/6 to 20/6 —
Yorkshire Hards	23/– to 24/– —
Derbyshire „	21/6 to 23/6 —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/– to 14/– —
Smalls	8/– to 10/– —
Blast-furnace Coke (Inland)*	— —
„ „ (Export)	f.o.b. 24/6 to 25/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/– to 29/–
Second „ „	27/– to 28/–
Best Dry Large	26/6 to 27/–
Ordinary Dry Large	25/– to 26/–
Best Black Vein Large	26/6 to 27/–
Western Valley „	26/– to 26/6
Best Eastern Valley Large	25/– to 26/–
Ordinary „ „	24/– to 25/–
Best Steam Smalls	17/– to 17/6
Ordinary „	15/6 to 16/6
Washed Nuts	25/– to 27/–
No. 3 Rhondda Large	28/– to 29/–
„ „ Smalls	22/6 to 23/–
No. 2 „ Large	24/– to 25/–
„ „ Through	20/– to 22/6
„ „ Smalls	15/– to 16/–
Coke (export)	47/6 to 55/–
Patent Fuel	28/– to 29/6
Pitwood (ex ship)	25/6 to 26/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	50/– to 52/6
Seconds	42/6 to 45/–
Red Vein	27/6 to 30/–
Machine-made Cobbles	57/6 to 62/6
Nuts	52/6 to 60/–
Beans	40/– to 43/–
Peas	24/– to 26/–
Breaker Duff	9/6 to 10/–
Rubbly Culm	14/6 to 15/6
Steam Coals:	
Large	24/– to 26/–
Seconds	22/– to 24/–
Smalls	15/– to 19/–
Cargo Through	18/– to 22/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o b. for export. (9) Per ton f.o.b.

* For blast furnaces only, 20/6 to 24/6; open market, 27/– to 28/–. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

German Competition.

THE engineering trades are beginning to consider seriously the situation that will be created in January next, when Germany will be freed from the economic restrictions imposed upon her by the Treaty of Versailles. Germany will then be able to impose heavy import duties and to take other measures that may practically prevent the importation of goods from this country. The results may be particularly serious for Alsace, which depends mainly upon Germany for the disposal of its manufactures. If makers in Alsace are unable to send their goods to Germany they will be obliged to find a market in France, which is only just able to absorb what is now being produced outside the restored provinces. Again, it is feared that any arrangement with Germany in accordance with the Dawes report will provide facilities to that country for developing its export trade, apart from the increased quantities of goods that may be supplied on account of reparations, and as the production costs in Germany are low, while those in this country are increasing, manufacturers are looking to the future with a good deal of apprehension. So critical is the situation financially and economically that French makers are alarmed at the idea of Germany being given a free hand for the development of her export trade.

Public Works in Algeria.

The carrying out of public works in Algeria is left largely to the initiative of the "financial delegations" representing the various categories of colonial and native populations, and after each delegation has examined what is necessary to be done in the interests of its special class there is a general meeting of the delegations to discuss the proposals to be made to the Government. In previous years most of the public works schemes presented to the delegations could not be carried out through the failure of the revenue from taxation to provide sufficient funds for the purpose. So urgent, however, has become the necessity to improve transport facilities, both by road and rail, and to carry out irrigation, drainage and other hydraulic works, that the financial delegations have decided upon the levying of new taxes which, it is expected, will provide 86 million francs annually during a period of five years. Among the works to be carried out with these funds will be the continuation of the railway programme of 1907 and an improvement to the existing railway system, as well as the building of roads and the draining of the Fetzara Lake. The 1920 programme of railway construction is to be postponed and the proposed harbour works will not be put in hand before 1926. A large expenditure will also be devoted to irrigation and drainage works in the three departments, the idea underlying the programme being that no more time must be lost in developing the agricultural resources of the colony and in providing the necessary means of transport.

Colonial Cotton.

The question of colonial cotton is constantly to the fore, and it has been dealt with again this week by M. Carde, the Governor-General of French West Africa, who has settled the problem of dry or irrigated cotton by declaring that the only way to produce cotton profitably is by irrigation. The production, he says, is five times that obtainable by the dry system of cultivation. The investigation into the methods of irrigating the Senegal and Niger Valleys is so far advanced that M. Carde declares it will be possible to begin producing cotton on a large scale next year. The transport facilities are being adequately provided for. Dakar is already the most important port on the West African Coast, and a further 40 million francs are to be spent upon its equipment. Since the opening of the line from Dakar to Kulikoro the traffic has grown so considerably that it promises to be more than double the estimated total for the present year.

New Patent Laws.

The patent legislation in France differs from that in most other countries in the sense that there is practically no opposition and no objection to claims. There is no preliminary examination and, except in certain specified cases, the applications are always accepted, with the result that the owner of a French patent has no guarantee of its validity unless it has successfully passed through the examination stage abroad. The owner of a French patent cannot be assured of protection until it has been upheld in a court of law, but the law is a strong deterrent of infringement by being usually tolerant towards inventors and making infringement a costly offence. A Bill has now been introduced by the Government to reform the patent legislation by ensuring a preliminary examination and increasing the duration of patents from fifteen to twenty years. The idea is to bring the legislation into line with that of other countries adhering to the International Convention. The new law will follow in many particulars the features of the British legislation in the way of according more protection to inventors. When a patent has been worked for five years without objection it may be sustained, even though an anticipation, until then unknown to the patentee, may be discovered.

The Steamer Le Nord.

After being in service for thirty years between Calais and Dover, the steamer Le Nord recently made its last journey to Dunkirk to be broken up. This old paddle steamer had a remarkably fine record and rarely failed to effect a crossing, even in the worst weather, and when all the other Channel steamers were held up Le Nord could nearly always be depended upon to carry the mails. The sister ship Pas de Calais was broken up last year, so that the paddle steamer has definitely disappeared from the main Channel routes.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

217,081. July 27th, 1923.—ROTARY STEAM GENERATORS, J. V. Blomquist and K. F. Wessblad, Lästmakarigatan, Stockholm.

This specification is concerned with a development of the previous invention of the same engineer, and is intended to extend the use of rotary water tubes for boilers to extremely high pressures, in which case the tubes must be of small diameter, and it is difficult to arrange for inspection and cleaning doors. The tube A of the rotary steam generator has a collar B, which, as

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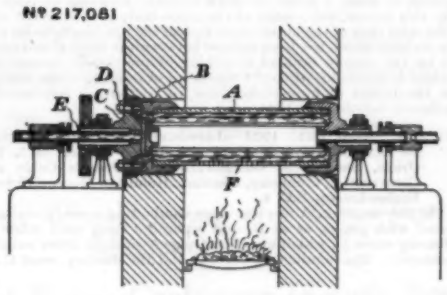

shown on the drawing, is threaded and welded on the tube. To this collar, a cover C is attached by means of screws D. In this cover, which is centered at the tube and furnished with a tightening device, the water inlet E to the rotary steam generator is also provided as well as the end journal of the tube. For an inspection or cleaning of the tube or for inserting and removing carriers F that may be fitted in the tube for causing the water to take part in the rotation, the cover C is removed from the tube, whereafter the interior will be easily accessible.—*June 12th*, 1924.

INTERNAL COMBUSTION ENGINES.

217,138. December 1st, 1923.—SUPERCHARGED ENGINES, G. Fornaca, 7 Via Giannone, Turin, Italy.

This invention is concerned with the control of the air supply to supercharged engines. The compressor for supplying air to the engine is shown at A, and delivers by the pipe B. This pipe has a branch C, which leads to a piston valve D. The valve is controlled by the spring E, the tension of which can be varied

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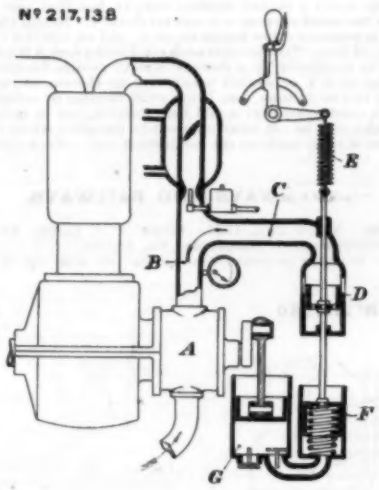

by hand, and by the piston F. A vacuum is maintained beneath the piston F by the air pump G. The several parts are so adjusted that at sea level the valve D is pulled down to the full open position, and some of the air delivered by the compressor escapes without going to the engine. As the barometric pressure falls the valve D closes, and more compressed air is supplied to the engine.—*June 12th*, 1924.

217,147. December 14th, 1923.—LUBRICATION, The Vulcan Motor and Engineering Company, Limited, S. G. Gregg and E. Frost, Crossens, Southport, Lancs.

In this arrangement there is a horizontal cam shaft A, and this carries right angle gearing B driving a vertical spindle C. This spindle is hollow for only a part of its length, as shown at D, and it extends down into the bottom of the crank case E or oil sump. The bottom end carries a pair of gear wheels F, which form an oil pump. They are enclosed in a casing, on one side of which is formed an oil inlet orifice. The other side of the casing communicates, by means of a groove G, with the passage D in the hollow driving spindle. The oil is therefore forced up the driving spindle, from which it flows through holes into a chamber surrounding the spindle. From here the oil travels outside the spindle C, and then through passages H to the centre of the filter chamber J. The oil travels through this filter and passes through passages K to a recessed cap L at the end of the hollow cam shaft A. From the cap L a duct M leads off to the adjacent crank shaft bearing N, and for the lubrication of the other bearings there are radial holes in the cam shaft opposite the other cam shaft bearings O and P. From these bearings, ducts lead to the adjacent crank shaft bearings. In one side of the filter chamber there is

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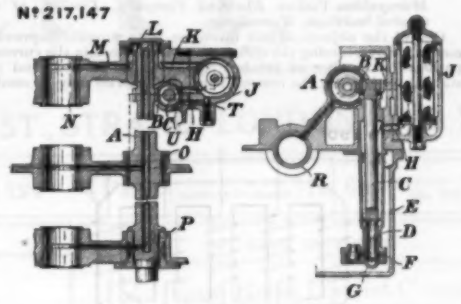

a ball release valve T past which excess oil may return to the crank case through a passage U.—*June 12th*, 1924.

TURBINE MACHINERY.

216,960. March 13th, 1923.—HYDRAULIC TURBINES, L. F. Moody, 408, W. Chilten-avenue, Germantown, Pennsylvania.

This invention relates to hydraulic turbines, and particularly to turbines of high specific speed, through which large quantities of water flow at high velocity compared with the net head on the plant. The object is to provide a turbine installation in which large quantities of water can be handled within a limited space, and within which the water can be set in motion at high velocity and again retarded to a low velocity at discharge with minimum loss of head, and may impart to the turbine runner a high velocity

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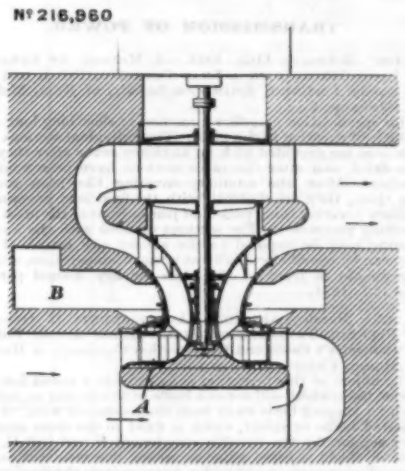

of rotation. The working parts are readily accessible outside the water passages while the turbine is in operation. Another object of the invention is to provide a turbine in which the intake and outflow passages are adapted to produce a whirling body of water within which the runner rotates at high speed, and to decelerate the velocity of whirl in a draught tube spreading outward away from the turbine axis on all sides, so as efficiently to regain the kinetic energy of the water leaving the runner. As will be seen from the drawing, the turbine is of the upward flow type, and has a propeller form of runner. The mechanism for operating the guide vanes A is accessible from the passage B.—*June 12th*, 1924.

DYNAMOS AND MOTORS.

210,441. January 24th, 1924.—IMPROVEMENTS IN AUTOMATIC CENTRIFUGAL SWITCHES FOR ELECTRIC LIGHTING MACHINERY, "Frankonia Aktiengesellschaft vorm. Albert Frank," of Beierfeld i/Sachsen, Germany.

The device described in this specification is applicable mainly to electric lighting systems on motor cycles and bicycles. The diagram relates to a two-pole switch arrangement for use with a four-part T armature with an open winding and a four-part commutator. The starting points of the two coils are connected directly to the segments A and B of the commutator, and the ends lead to the contacts B C, which are insulated and mounted on the support D. The latter also carries insulated spring

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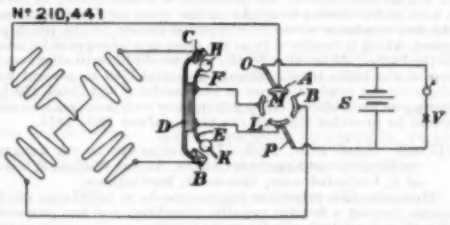

leaves E F, fitted with weights H K, which serve as contacts. The springs E and F are connected to segments L and M of the commutator. The storage battery S is connected by means of brushes O P. V is the circuit containing the current-consuming devices. The operation is as follows:—On the speed being attained which is required for generating a voltage equal to that of the storage battery, the centrifugal masses H and K, which are constructed as contacts, are caused by the centrifugal force to enter the contacts C and B, and thus close the circuit as follows:—First coil: Segment A armature winding, contact B—K, segment L, brush P, storage battery, and brush O back to segment A. Second coil: Segment B, armature winding, contact C—H, segment M, brush O, storage battery, and brush P,

back to segment B. Contact is therefore made completely without friction.—*June 12th*, 1924.

196,290. June 12th, 1924.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CURRENT COLLECTING BRUSH DEVICES, *The Metropolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.*

One of the objects of this invention is to provide improved means for overcoming the difference of impedance in the current paths of a number of brushes connected in parallel, and to stabilise or balance the current flow. The device may be easily

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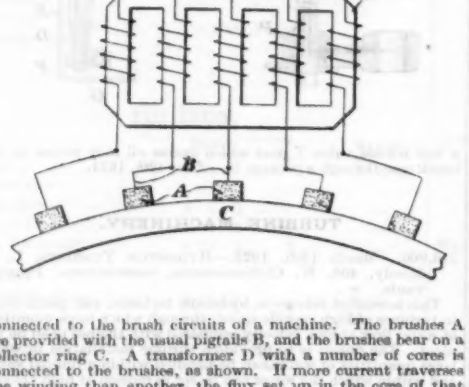

connected to the brush circuits of a machine. The brushes A are provided with the usual pigtails B, and the brushes bear on a collector ring C. A transformer D with a number of cores is connected to the brushes, as shown. If more current traverses one winding than another, the flux set up in the core of that winding will be greater than that produced by the windings carrying the smaller current, and a state of equilibrium of current flow in the windings is established.—*June 12th*, 1924.

TRANSMISSION OF POWER.

211,469. February 11th, 1924.—A METHOD OF SHEATHING LONG CABLES WITH A LEAD COVERING, Felten and Guilleaume Carlswerk Action-Gesellschaft, of Köln, Mulheim, Germany.

This specification describes a method of sheathing long cables with a lead covering in one piece. The individual sections of the cable core are provided with an auxiliary cover after they have been dried, and after the cable sections have been connected together. After the auxiliary covering has been removed from them, they are sheathed with the final lead covering, the auxiliary covering being pulled off just in front of the press as the sheathing progresses. The sections covered with the auxiliary covering may be exposed to the air for any length of time. They can be tested electrically at normal temperature, and they may remain in front of the press for any desired period.—*June 12th*, 1924.

216,965. March 16th, 1923.—IMPROVEMENTS IN OVERHEAD ELECTRIC TRANSMISSION LINES, Alfred Arnold Bull and Callender's Cable and Construction Company, of Hamilton House, Victoria Embankment.

The object of this invention is to provide a guard for transmission lines, which will act as a baffle or shield, and an insulated perch for keeping birds away from the conductor wire. A is the insulated baffle or shield, which is fixed to the cross arm D or other support by the metallic attachment B and bolt C. This baffle or shield is fitted adjacent to the line insulator carrying the conductor wire, and at such a distance from the line insulator as to prevent birds perching on the cross arm or support between the line insulator and the baffle or shield. To this insulated

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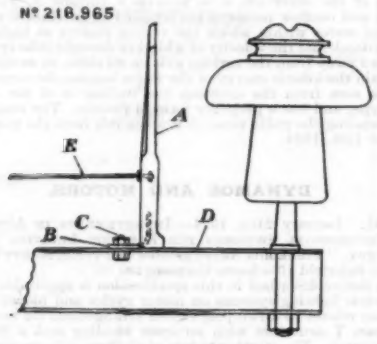

baffle a rod or rods E is attached on the side remote from the line insulator. This rod, which forms the perch, is made of metal or other suitable material, and is attached to the baffle A above the cross arm or support, as indicated on the drawing. It will be seen that by the provision of a bird guard, as shown, a bird endeavouring to alight on the cross arm or support near the line insulator would be compelled to rest on the perch provided, which is insulated from the cross arm or support by means of the baffle. Alternatively, the bird would have to alight on the top of the baffle itself. Should a second bird or several birds alight on the conductor wire or line insulator and touch the bird resting on the baffle or the perch, no low resistance path to earth would be provided through the birds.—*June 12th*, 1924.

217,002. April 20th, 1923.—IMPROVEMENTS IN OR RELATING TO MULTI-CORE ELECTRIC CABLES, Arthur William Williams, of 6, Cavindish-vale, Sherwood, Nottingham.

This invention relates to improvements in multi-core electric cables, having a flexible metallic sheathing, and has particular, though not exclusive, reference to cables employed as trailing cables for conducting current to electrically operated machines, for example, electrically operated coal-cutting machines, in cases in which the earthing system has two earth conductors which normally carry current. An object of the invention is to construct the cable so that, in the event of fracture or damage, the metallic sheathing which is employed, as one of the earth conductors, is prevented from penetrating to the core or conductor constituting the second earth conductor, and short circuiting the two earth conductors. Another object of the invention is to provide a cable of the above type, which possesses greater flexibility than cables as hitherto constructed, while a further object is to reduce the likelihood of fracture of the braided metal forming the metallic sheathing. The cable contains a number of cores or conductors A B, incorporated in the rubber or similar body C a metallic braided sheathing D, and an outer protecting cover E of rubber or similar material surrounding the sheathing. The two earth conductors are constituted by the core or conductor B and the sheathing D, and the core or conductor B employed as the one earth conductor is situated centrally in the cable body C throughout the length of the cable, the power current cores or conductors A being twisted, as shown. In the event of fracture or damage to the cable, resulting in the metallic earth sheathing D being forced inwardly, it is practically impossible for the sheathing to penetrate to the central earth core B and establish a short circuit on both earth conductors. Further, to increase the flexibility

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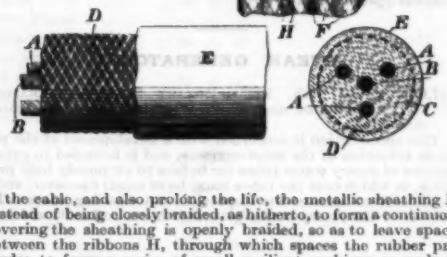

of the cable, and also prolong the life, the metallic sheathing D, instead of being closely braided, as hitherto, to form a continuous covering the sheathing is openly braided, so as to leave spaces between the ribbons H, through which spaces the rubber protrudes to form a series of small resilient cushions or pads F. By this means, the rubber of the cable body C is in direct contact with that of the outer cover E, and the practically solid wall or division which has been formed between the body C and cover E by the closely braided sheathing of previously constructed cables is avoided; while the likelihood of fracture of the ribbons at the points of intersection, due to friction, is considerably reduced.—*June 12th*, 1924.

217,000. April 18th, 1923.—IMPROVEMENTS IN OR RELATING TO ELECTRIC CABLES, Frederick James Cooper, of 5, The Oriels, Shawlands, Glasgow, and Callender's Cable and Construction Company, Limited, Hamilton House, Victoria Embankment, E.C. 4.

In the drawing, A are the three conducting cores, each insulated with paper, as at B, and separated from each other by dummy cores C, which may be of paper, jute, or other suitable material. The conducting cores A and the dummy cores C are

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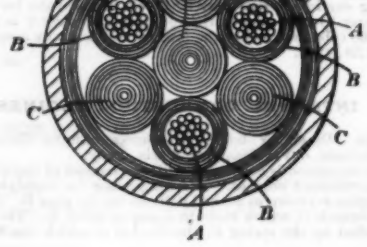

laid up round a central dummy core D, but that core merely serves the usual purpose of a central dummy. Round the whole cable is paper or other insulation at E, and an exterior covering F, say, of lead. The fact that each conducting core A is separated from its neighbour by a dummy core C, greatly facilitates the making of a T or similar connection to the conducting core, owing to the dummy core being more flexible or compressible than a conducting core would be. Further, one or both of the dummies may be cut away adjacent to the place where the connection is to be made to the conducting core.—*June 12th*, 1924.

TRAMWAYS AND RAILWAYS.

216,980. March 28th, 1923.—RAILS, A. J. Reddy, 88, Upper George's-street, Kingstown, Co. Dublin.

The inventor proposes a composite rail built up of two or

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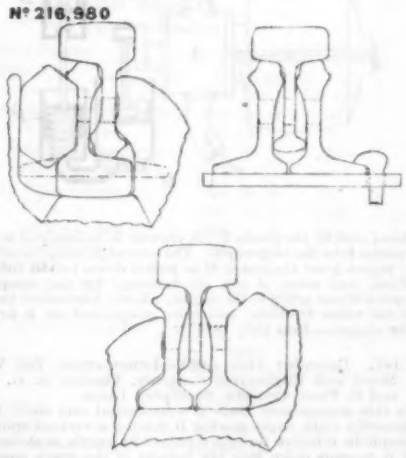

three pieces bolted together with the joints staggered, so that fish plates are unnecessary. The drawings show three alternative designs.—*June 12th*, 1924.

MACHINE TOOLS AND SHOP APPLIANCES.

217,124. October 25th, 1923.—NAIL-MAKING MACHINES, Malmedie and Co. Maschinenfabrik-Acktiengesellschaft, and A. Globig, Corneliusstrasse 25, Dusseldorf, Germany.

This wire nail-making machine will make nails of any desired length, as the headed wire can be fed forward to any extent before it is cut off and pointed. The heading hammer A is pulled up against the wire B by the crank C, and meanwhile the wire is gripped between the dies D D, the lower one of which is actuated

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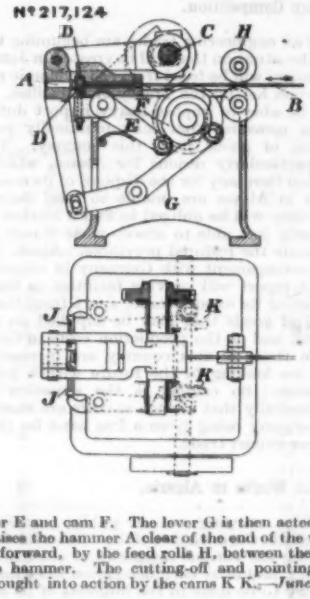

by the lever E and cam F. The lever G is then acted on by the cam and raises the hammer A clear of the end of the wire, which can be fed forward, by the feed rolls H, between the bifurcated legs of the hammer. The cutting-off and pointing tools J J are then brought into action by the cams K K.—*June 12th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, JULY 19TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—District meeting in the Council Chamber, Municipal Buildings, Newbury. 11 a.m.

PHYSICAL SOCIETY OF LONDON.—Special meeting at Cambridge. Visit to the works of the Cambridge and Paul Instrument Company and inspection of the Cavendish Laboratory. Papers: (1) "Radiations in a Discharge Tube," by Sir J. J. Thomson, O.M., F.R.S.; (2) "Recent Experiments on the Artificial Disintegration of the Elements," by Sir Ernest Rutherford, F.R.S., and Dr. J. Chadwick; and (3) "A Two-dimensional Recording Accelerometer for Aeroplane Research," by Dr. G. F. C. Searle, F.R.S. Train leaves Liverpool-street Station (G.E.R.) 8.30 a.m.

WEDNESDAY, JULY 23RD.

THE INSTITUTION OF GAS ENGINEERS.—28, Grosvenor-gardens, Westminster, S.W. 1. Special meeting for the purpose of submitting for confirmation certain resolutions passed at the annual general meeting on June 24th. 5 p.m.

THURSDAY, JULY 24TH.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 7 for 7.30 p.m.

FRIDAY, JULY 25TH.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Connaught Rooms, Great Queen-street, London, W.C. 2. Costing Conference. 11 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District meeting at Bradford.

SATURDAY, JULY 26TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Wales District meeting. The Town Hall, Pontypool 10.30 a.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to state that Mr. Andrew S. Macharg, C.A., has joined the board of directors of the Scottish Tube Company, Limited. Mr. Macharg is one of the senior partners of Messrs. McClelland, Ker and Co., chartered accountants, Glasgow.

WE are informed that the Westminster Tool and Electric Company, Limited, of Westool Works, Putney, S.W. 15, has appointed the Autocar Electrical Equipment Company, of Mitchell-street, E.C. 1, as its sole selling agent for Westool commutators for automobile use.

STOTHERT AND PITT, Limited, of Bath, inform us that the resignation of their chief engineer, Mr. C. M. Toplis, will not affect the manufacture of their patent horizontal luffing cranes—"Toplis" patents—the sole interests and any subsequent improvements in the patents being assigned exclusively to them.

FULLER'S UNITED ELECTRIC WORKS, Limited, of Chadwell Heath, Essex, inform us that the area under the charge of their Newcastle agents, A. S. McHugh and Co., of 59, Side, Newcastle-on-Tyne, now includes the whole of the counties of Northumberland and Durham, North Yorkshire, including the Teesside district, Scarborough, Richmond, &c., North Cumberland, including Whitehaven. Messrs. Fullers have also appointed the North-Western Electric Company, Limited, of Barrow-in-Furness, their selling agent for cables and wire for the Barrow-in-Furness and Lake districts and North Lancashire, including Lancaster, Morecambe, &c.